U.S. Department of the Interior
Bureau of Land Management

DRAFT

Roseburg District Office
777 N.W. Garden Valley Boulevard
Roseburg, Oregon 97470

August 1992

Roseburg District Resource Management Plan and Environmental Impact Statement

Volume II

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

BLM-OR-PT-92-31-1792

Appendices

Table of Contents

Chapter 1 Appendix

Appendix 1-1
Summary of Scoping

Scoping of the Roseburg District Resource Management Plan/Environmental Impact Statement (RMP/EIS) began in September 1986, when a mailer was sent to a mailing list of some 1000 parties, inviting them to identify issues and concerns for BLM to consider in the planning process. An open house was held by BLM's Roseburg District during the comment period, to help interested parties focus on the question.

With the comments received, the district's planning team and managers distilled a list of issues and concerns. BLM distinguished an issue as a matter of controversy or dispute over resource management activities or land use that is well defined or topically discrete and can be addressed in the formulation of planning alternatives. In practice, issues are resolved by resource allocations and restrictions. Concerns, on the other hand, are generally not so well defined, or do not directly involve controversy or disputes over resource management activities or land use allocations, and do not lend themselves to formulating land use alternatives. Concerns are usually addressed by analysis and documentation in the RMP/EIS. Some concerns are not addressed by the RMP/EIS, as they are beyond the control of the State Director, are unrelated administrative problems, or are not within the legal jurisdiction of BLM.

The issues and concerns identified are described in Chapter 1. This list of issues and concerns was sent to interested parties in March of 1987.

Further scoping after March of 1987 related to refinement of the issues, and determination of a reasonable range of alternatives to address in the RMP/EIS. The latter facet of scoping was handled through the development of State Director guidance for formulation of alternatives. The development of State Director guidance for the RMP process is discussed in Appendix 1-5.

In public comments and internal discussions, there were a number of alternatives, or potential elements of alternatives, considered but eliminated from detailed analysis. These are summarized in the following discussions:

- Alternatives that would meet specified timber production target levels (e.g., one identified in a regional supply analysis or one that would maintain the level in existing plans). Such alternatives could be explicitly designed only with an optimization model. Early in the planning process, BLM chose not to invest the many millions of dollars that would have been necessary to adopt and use an optimization model in its western Oregon planning effort.
- Alternatives that explicitly reflect the policies and programs of the O&C counties, and of the State. Until opportunities and tradeoffs are fully analyzed, such alternatives could not be formulated. At that point in the process, it was BLM's intent to develop a preferred alternative consistent with those policies and programs to the extent they are consistent with each other and also consistent with Federal laws and regulations.
- An alternative based on the assumption that FLPMA, rather than the O&C Act, was the predominant statutory mandate for management of the O&C and CBWR lands. None of the initial set of alternatives was based on a specific real or assumed statutory mandate. BLM believes that management under FLPMA falls within the range established by the initial set of alternatives.
- A "no planned timber harvest" alternative. BLM considers such an alternative for all BLM-administered lands in western Oregon outside the reasonable range of alternatives. The counterpart of a no-timber-harvest alternative would be an alternative that would remove all merchantable timber over the life of the plan. Such a radical departure from sustained yield principles on either end is clearly outside the reasonable range of alternatives.
- An alternative which would forego slash burning; one that would forego use of herbicides. These activities and the options of foregoing them were addressed in BLM's "EIS, Western Oregon Program-Management of Competing Vegetation," 1989. This RMP/EIS is tiered to that EIS.
- An alternative that uses uneven-aged management as the predominant silvicultural system. In many locations that prescription would fail to meet reforestation standards, a violation of the sustained yield mandate. Uneven-aged management has been considered for use in stands where it would be economically and environmentally feasible and reforestation standards could be met.

- An alternative which excludes Site IV lands from timber harvest. Such an alternative would not address any important environmental or resource management objectives better than options already being addressed.

- An alternative that maximizes timber production subject to the constraint of economic feasibility. Rather than design and fully analyze an entire alternative with this constraint, BLM concluded that it was more appropriate to run a sensitivity test of alternative A, showing the nondeclining timber harvest level if it were so constrained. In the Roseburg District, the economic feasibility test showed a difference in ASQ of less than one percent.

- Alternatives which vary in size of spotted owl habitat protected for each nest site. In light of the Interagency Scientific Committee report and subsequent proposals by the Fish and Wildlife Service, BLM concluded that such variation had little relevance.

- An alternative that would protect 110 spotted owl areas, as provided for in the 1987 revised BLM-ODFW agreement, was originally proposed by BLM. After the Interagency Scientific Committee report was released in 1990, this alternative no longer seemed relevant.

- Alternatives that would maintain older forest blocks by managing large blocks of about 3,000 acres and small blocks of about 200 acres on a 350-year rotation. Such alternatives were originally proposed by BLM, but were dropped when both the Interagency Scientific Committee report and protective Congressional bills stressed not harvesting important older forest stands at all. A sensitivity analysis of alternative B was substituted, which comes close to the suggested approach.

- An alternative originally proposed by BLM would have tried to provide optimal habitat diversity through habitat management for all priority species. It would have allocated enough lands in extended (350-year) rotations so that mature and old-growth stands would represent at least 30 percent of BLM-administered forest land. This alternative was dropped in favor of the management constraints of a Congressional bill, which were incorporated into alternative E.

- Alternatives that allocate a considerable percentage of the land base to timber production but place half or more of that land on extended rotations of 150 years or longer. Most components of such an alternative would be identifiable from other alternatives and sensitivity analyses, but a specific sensitivity analysis of alternative B was added, putting all lands allocated primarily to timber production on a rotation of 150 years.

- Alternatives which vary in snag (wildlife tree) protection from 20 percent to 80 percent of optimum population levels. Although such variation is not an explicit objective of the alternatives, they were expected to vary that widely.

- An alternative that manages as VRM Class II all lands inventoried as VRM Classes III and IV. Such an alternative would only be logical if matched with the other goals of an alternative with a timber harvest base at least as constrained as alternative E. This management option, intended to optimize protection of scenic values even on areas identified in inventories as low in scenic value, was felt to be unreasonable in light of the many other constraints on alternative E.

- An alternative that provides a transition zone on intermittent streams which leaves an undisturbed soil mantle and vegetation, but not necessarily standing timber. While this would be a relevant objective to entertain, it would not be practical, because harvesting timber under such constraints would often not be economically feasible.

- An alternative protecting a minimum of 1/4 mile-wide riparian management areas (RMA) along third order and higher streams, Class I streams and other waters; and maintaining and enhancing water quality at the highest level of water quality required for municipal use. Such an alternative would exclude almost all commercial forest lands from timber management. Such extensive RMAs would be far in excess of what is needed to protect water quality and riparian values. Thus, it was considered outside the range of reasonable alternatives.

Appendix 1-2. Legal Guidelines

The following statutes and executive orders (as amended) constitute the major legal guidance for planning and management of lands administered by BLM in western Oregon. This list is not necessarily all inclusive but does represent the primary legal guidance to be considered in preparation of the Resource Management Plan.

Federal Land Policy and Management Act of 1976 (FLPMA)	43 USC 1701
The O&C Sustained Yield Act of 1937	43 USC 1181a
National Environmental Policy Act of 1969 (NEPA)	42 USC 4321
Environmental Quality Improvement Act of 1970	42 USC 4371
Executive Order 11514, Protection and Enhancement of Environmental Quality (1970)	
Taylor Grazing Act	43 USC 315
Recreation and Public Purposes Act	43 USC 869
Unlawful Inclosures or Occupancy Act	43 USC 1061
Mining and Minerals Policy Act of 1970	30 USC 21a
Mining Act of 1872	30 USC 26
Mineral Leasing Act of 1920 (Mineral Lands Leasing Act)	30 USC 181
Materials Act of 1947	30 USC 601
Geothermal Steam Act of 1970	30 USC 1001
Geothermal Energy Act of 1980	30 USC 1501
Antiquities Act of 1906	16 USC 431
Historic Sites, Buildings, and Antiquities Act	16 USC 461
National Historic Preservation Act	16 USC 470
Archaeological Resources Protection Act of 1979	16 USC 470aa
Reservoir Salvage Act of 1960	16 USC 580m-n
Fish and Wildlife Coordination Act	16 USC 661
Bald Eagle Protection Act	16 USC 668
Sikes Act	16 USC 670a
Migratory Bird Treaty Act	16 USC 703
Migratory Bird Conservation Act	16 USC 715
Wilderness Act	16 USC 1131
National Trail Systems Act	16 USC 1241
Wild and Scenic Rivers Act	16 USC 1271
Executive Order 11644, Use of Off-Road Vehicles on the Public Lands (1972)	
Executive Order 11989, Off-Road Vehicles on Public Lands (1977)	
Wild Free-Roaming Horses and Burros Act	16 USC 1331
Coastal Zone Management Act of 1972	16 USC 1451
Endangered Species Act of 1973	16 USC 1531
Soil and Water Resources Conservation Act of 1977	16 USC 2001
Executive Order 11988, Floodplain Management (1977)	
Executive Order 11990, Protection of Wetlands (1977)	
Coastal Barriers Resources Act	16 USC 3501
Land and Water Conservation Fund Act of 1965	16 USC 4601-4
Federal Water Pollution Control Act/Clean Water Act	33 USC 1251
Safe Drinking Water Act	42 USC 300 (f)
American Indian Religious Freedom Act	42 USC 1996
Resource Conservation and Recovery Act of 1976	42 USC 6901
Clean Air Act	42 USC 7401
Comprehensive Environmental Response, Compensation and Liability Act of 1980	42 USC 9601
Emergency Planning and Community Right-to-Know Act of 1986	42 USC 11001

Appendix 1-3. Portions of *Record of Decision, Northwest Area Noxious Weed Control Program*

The following is verbatim from the *Supplemental Record of Decision, Northwest Area Noxious Weed Control Program* of May 5, 1987. (The remainder of the Supplemental Record of Decision, including the Rationale, is incorporated by reference):

The Decision and Its Specific Provisions

To control or eradicate noxious weeds, BLM will use six commercial products containing herbicides: Banvel, Rodeo, Tordon 22K, Tordon 2K, Esteron 99 and DMA-4. These formulations contain different herbicides designed to kill or retard the growth of noxious weeds: dicamba in Banvel; glyphosate in Rodeo; picloram in Tordon 22K and Tordon 2K; and 2,4-D in Esteron 99 and DMA-4.

BLM will use the herbicide formulations as part of its ongoing program for controlling or eradicating noxious weeds. BLM has been using three methods. If noxious weeds are susceptible to insects, pathogens, or grazing by goats or sheep, BLM may introduce those biological agents to retard weed growth. BLM may also use laborers to manually remove noxious weeds and apply mechanical treatment—burning, mowing, and tilling. With this record of decision, BLM may use the herbicide formulations as a fourth technique.[1]

The provisions governing the use of Banvel, Rodeo, Tordon 22K, Tordon 2K, Esteron 99 and DMA-4 to control or eradicate noxious weeds parallels the features stated under Alternative I in the FEIS, Chapter I; the SEIS, Appendix I; and BLM policy statements and manuals referred to in those documents. The word "parallels" is used because the decision in several instances differs from the original proposal by requiring the more judicious use of the substances to avoid or minimize environmental effects of their use.

BLM will apply Banvel, Rodeo, Tordon 22K, Tordon 2K, Esteron 99 and DMA-4 only in accordance with the standards that the Environmental Protection Agency (EPA) imposes upon their public use. These standards are stated on the product labels.

BLM will use the commercial products only if the noxious weeds targeted for treatment are susceptible or highly susceptible to their herbicides. What this means is that the commercial products' herbicides, with one treatment, can retard at least 85 percent of the growth of the targeted noxious weeds. BLM will not use herbicide formulations if another method is more effective.

The herbicide formulations may be applied by helicopter; by ground vehicles equipped with boom or hand-gun sprayers; or by workers with backpack sprayers, broadcast cyclone sprayers, or tools for hand wiping the substances onto the plants.

Ordinarily, two considerations govern the choice of method. The choice first depends upon the treatment objective, topography of the treatment area, expected costs, and equipment limitations. The second consideration is the selectivity of the herbicides. Since Rodeo, which contains glyphosate, is not selective in the plants it kills or retards, it may be applied only from the ground to the noxious weeds targeted for treatment. And because the other herbicide formulations are toxic to conifer seedlings, the same restriction applies to how these herbicides are applied if conifers are being grown as commercial timber on the site to be treated. The restriction does not apply once the conifer seedlings become dormant, usually in the late summer. Unless conifers are present, the herbicides in Banvel (dicamba), Tordon 22K and Tordon 2K (picloram), and Esteron 99 and DMA-4 (2,4-D) may be applied by any method.

In applying the herbicide formulations, BLM will also abide by the following measures to reduce environmental impacts. None of the products may be applied within 500 feet of any residence or other place of human occupation unless the occupant or resident gives his consent in writing. Commercial products will not be applied within l00 feet of any croplands or by helicopter within l00 feet of any surface waters or identified ground water recharge area. Nor will the commercial products be applied by ground vehicles equipped with boom sprayers within 25 feet of any waters. Spot treatments with vehicle-mounted hand-guns or with backpacks will not be applied within 10

[1]BLM will not use products containing dicamba, glyphosate, picloram, and 2,4-D on public lands administered by its Oregon State Office until the court dissolves its injunction in *Northwest Coalition for Alternatives to Pesticides v. Block et al.*, No 83-6272-E (D. Ore. 1984).

feet of water. Herbicides will be wiped on individual plants up to the current water line and will be applied by helicopters only when wind velocity does not exceed 5 miles per hour. Wind speeds may not exceed 8 miles per hour under any other herbicide application method.

Certain restrictions also govern the equipment used to apply the formulations. Spray nozzles on all helicopters and ground vehicles must be set to produce spray droplets with a median diameter of 200 microns or larger. Helicopter and ground vehicle equipment must also operate with a boom pressure of 20-35 pounds per square inch, unless the herbicide's label specifies a different pressure. Aerial applications must be within 100 feet of the ground. Backpack applications of liquid formulations will be allowed only with low nozzle pressure and within 2.5 feet of the ground. Granular formulations will be applied by broadcast spreaders only within 3.5 feet of the ground.

One final set of restrictions governs the maximum amount of the herbicides in each of the commercial products that may be applied. The FEIS, as modified by the SEIS, includes a table showing the maximum rates of application. BLM's proposal was to apply dicamba at 6 pounds per acre, glyphosate at 3 pounds per acre, picloram at l pound per acre, and 2,4-D at 3 pounds per acre. If, however, small animals susceptible to dicamba or 2,4-D are on the site to be treated and represent sensitive wildlife species in the area, BLM will not use these substances if glyphosate or picloram can be used instead. Or, if that is not possible, BLM will substantially reduce the amount of dicamba or 2,4-D to be applied per application. In addition, BLM ordinarily will apply the commercial products only once a year to any site and, except under circumstances where control or eradication goals are not achieved, no more than three times during the program's span.

The provisions governing BLM's use of herbicides in this program require measures to mitigate possible environmental effects. More mitigation measures are included in the FEIS, the SEIS, and the policy statements and manuals they cite. All are incorporated by reference into this supplemental record of decision. The purpose of the mitigation measures is to ensure the judicious use of the herbicides.

BLM projects that it will annually use the herbicide formulations to control or eradicate noxious weeds on about 21,300 acres of the public lands in the Northwest: 7,800 acres in Idaho, 5,600 acres in Montana, 6,600 acres in Oregon and Washington, and 1,300 acres in Wyoming.

BLM will treat public lands infested or potentially threatened by noxious weeds according to a set of priorities, which are detailed in the SEIS, page 119. The priorities represent BLM's commitment to pursue all existing methods for controlling or eradicating noxious weeds, including the use of herbicide formulations, with no undue reliance on any one means. The priorities detailed in the SEIS are part of this decision.

The following is verbatim from the original Record of Decision of April 7, 1986. (The remainder of the Record of Decision is incorporated by reference):

Management Emphasis

To give definition to the integrated management called for by this decision, the Bureau also shall treat public lands infested or potentially threatened by noxious weeds according to a set of priorities. The priorities are three-fold: (1) prevention, i.e., stopping noxious weed species from being introduced onto public lands; (2) eradication, i.e., halting the spread of noxious weeds by eradicating invading noxious weeds; and (3) control, i.e., limiting well established infestations competing with desired vegetation. The remaining program direction on setting priorities for treatment largely represents a paraphrase of the consensus reached in Idaho between the BLM State Office there and affected interests.

Priority I and II - prevention and eradication of new invaders. Prevention is often the most practical means of controlling noxious weeds. This priority shall be accomplished in part by educating public land users, and where possible, conditioning their use in a way that improves the chances that new weed seeds are not carried onto public lands. The agency's first treatment priority shall be stopping a given species from contaminating an area. More concretely, priority in treatment shall be given to those areas that noxious weeds have newly invaded. Eradicating new invaders shall have highest priority in treatment and funding.

Priority III - control. Weed species in this treatment priority are those that have become so established that for all practical purposes eradication is not feasible. Under this priority, noxious weeds will be treated for the purpose of reducing the population to a level that restores an area's ecological balance and productivity. The amount of control must be balanced between the costs involved and the prospect for success. Components of this category include: (1) emphasis will be placed on containing and preventing further spread of the infestation; (2) highest priority will be given to "breakouts" from the infested area and along rights-of-

way or adjacent to private property; and (3) biological agents, when and where available, will be emphasized on main infestations when the agent demonstrates practical effectiveness against the weed.

Program Design Features

To give further definition to the Bureau's program, and recognizing that the available techniques carry different costs, efficiencies and environmental risks, the decision adopts the program design features from the EIS (Appendix I and Chapter 1) for deciding upon and governing use of a particular technique. In stating the design features, the agency does so to make personnel charged with implementing the program aware of the concerns and

constraints about using different means. the design features are to strengthen and supplement the judgement of qualified agency professionals who have on the ground knowledge and familiarity with local conditions and needs.

Four chemicals are authorized for use under this decision. They are 2,4-D, picloram, dicamba, and glyphosate. Other or new herbicides could be proposed for use in the future, but before their use, all required environmental analysis, including a hazard assessment similar to that in Appendix K of the EIS, will be conducted and appropriately documented.

The Bureau will use the herbicide to which the targeted weed species is most susceptible and will be of lest detriment to non-target vegetation.

The chemicals may be applied individually or in combination. Glyphosate, picloram, dicamba and 2,4-D will be applied only when in accordance with the Environmental Protection Agency's label and registration restrictions. All safety requirements and project features described in Appendix I of the EIS will be followed. All application methods may be used for each herbicide except glyphosate; it will not be applied aerially.

Conditions indicating preference for a particular method of application are as follows:

- Applications using backpack spraying, hand wiping and cyclone broadcast spreading (granular formulations only) will be used in areas not accessible by ground vehicles. Treatment area will generally range in size from individual plants to a few acres.

- Applications using a vehicle mounted boom or handgun will be used in areas readily accessible by vehicle. Booms are used to treat continuous weed concentration areas (i.e., along rights-of-way) while handguns are used to treat concentrated spots.

- Aerial applications will be accomplished using helicopters to treat larger contiguous areas, but normally not exceeding 100 acres in size.

Minimum buffer strips will meet or exceed state-mandated standards for all herbicides applied.

- In aerial applications a 500 foot unsprayed buffer strip will be left next to inhabited dwellings unless waived in writing by the resident. A buffer strip of 100 feet will be left next to cropland and barns.

- Boom sprayers will not be used within 25 feet of water bodies.

- Granular formulations will be applied no closer than 10 feet from the high water line of streams and other water bodies.

- Contact systemic herbicides wiped on individual plants may be used up to the existing high water line.

Wind velocities for chemical applications of herbicides must be 10 mph or less in all instances. Where aerial applications of liquid herbicides are utilized, the wind speed must be 5 mph or less. Where vehicle and hand applications of herbicides are used, the wind velocity must be 8 mph or less except in riparian areas where the wind speed must be 5 mph or less.

Spray nozzles are designed for aerial and ground vehicles spray equipment to produce droplets large enough (200 microns or larger) in order to limit the amount of drift. Aerial application equipment will normally operate with a boom pressure of 20 to 35 pounds per square inch, unless the product label specifies a different pressure. Backpack application of liquid herbicide will occur with low nozzle pressure and within 2.5 feet of the ground surface. Applications of granular formulations through use of broadcast spreaders occur from about 3.5 feet above the ground.

Four major methods of manual and mechanical control are authorized for use under this decision. These are hand pulling and using hand tools, tillage, mowing and controlled burning.

- Hand pulling and using hand tools to remove noxious weeds may be used when no other

means is available to control or eradicate the targeted noxious weed.

- Tillage, either by burial or disturbing the root system, to control or eradicate noxious weeds may be used under these circumstances:
  - slope does not exceed 10 percent.
  - nontarget species adversely affected represent an insubstantial amount of vegetation cover or forage for wildlife.
- Mowing may be used to control or eradicate noxious weeds under these circumstances:
  - the targeted noxious weed lacks rosettes or rhizomes and fails to produce seed heads close to the ground.
  - the targeted noxious weed is`easily accessible by vehicles.
- Controlled burning may be used to control or eradicate noxious weeds under these circumstances:
  - the targeted noxious weed represents the vast majority of plants in the treatment area.
  - the burn is in accordance with BLM's Fire Management Policy (BLM Manual 9210).
  - the burned area can be rehabilitated to prevent erosion and resource degredation.
  - burning permit, when required, must be obtained.

Biological agents will be considered for use where they have demonstrated practical effectiveness in controlling the target noxious weed species. This does not preclude the use of biological agents from an experimental standpoint.

Each biological agent must be cleared for use on the targeted noxious weed as required under Executive Order No. 11987 (May 24, 1977). The following conditions are the most favorable for successful biological control.

- The biological agent is highly selective and will only affect the weed species intended for control.
- The mobility of the biological agent is sufficient to allow spread among the targeted weed community.
- The development of populations of biological parasites should be able to overtake the population of the target weed species.
- Biological agents used in a particular area or region of the targeted noxious weed should be able to adapt and be capable of surviving and reproducing.

Mitigation Measures

A number of mitigating measures which exceed standard BLM requirements, have been identified in the Environmental Impact Statement and are adopted by this Record of Decision. The program design features just announced also can be thought of as mitigating measures. In addition to the measures governing chemical treatments announced in the project design feature section here and the EIS, the following provisions also apply.

1. Due to the low no observable effect level (NOEL) for reproductive effects from Dicamba, female applicators will be restricted from working with Dicamba.

2. Due to the lowered margin of safety for the mixer loader from accidents, the mixer loader will wear a full length apron, face shield, rubber gloves, and liquid repellant footwear during the mixing and loading operation.

3. To prevent gross errors in the field in mixing, regular testing on field calibration and calculation will take place.

4. Due to the remote nature of the treatment areas, sufficient clean water will be available on the sprayer mixing and project sites to assure the opportunity for workers to wash off any chemicals splashed inadvertently onto skin.

To reiterate, all chemicals will be applied only when it is in accordance with EPA standards specified on the herbicide's label.

Monitoring and Studies

Table 1 summarizes the major monitoring activities which will be conducted under the decision. The purpose of the monitoring plan is to ensure that implementation occurs as planned and to ascertain the effectiveness of project design features and mitigation measures in meeting planned objectives. Information gained from monitoring will also be used to develop an improved data base from which to build future plans.

Much of the monitoring will be accomplished through normal operating procedures such as contract administration and staff review. Special systems have been developed to measure the biological and physical impacts of plan implementation. For example, control effectiveness will be monitored by post-treatment surveys designed to measure the actual effectiveness of a treatment or combination of treatments. When appropriate, monitoring will include recommendations for additional treatment and/or site rehabilitation.

Implementation and Additional Analysis

This Record of Decision is the next followup program step after completion of a final EIS. The process includes selection of the best alternative, or combination of alternatives, which in this case is Alternative 1. The decision becomes effective upon signature and issuance of this ROD, and BLM will proceed to implement the decision.

The EIS is a regional programmatic statement for controlling noxious weeds on BLM-administered land in Idaho, Montana, Oregon, Washington, and Wyoming and is intended to guide this program for the next 10-15 years. Site-specific environmental analysis and documentation (including application of categorical exclusions where appropriate) will be accomplished at the district level on proposed weed control plans. During site-specific analysis and documentation, public involvement will occur in accordance with the CEQ Regulations for implementing NEPA. Interdisciplinary impact analyses will be based upon this and other EISs, such as resource management plan, timber management plan, and grazing management plan EISs.

If analysis finds potential for significant impacts not already described in an existing EIS, another EIS or a supplement to an existing EIS may be required.

Table 1. Monitoring Plan

Monitoring Element	Method	Frequency	Characteristics Evaluated
Pretreatment Survey	On site visual inspection	Each treatment area	Species present, density endangered species present, control options, method chosen
Post Treatment Survey	On site inspection	Each treatment area	Effectiveness, need for retreatment, corrective measures or mitigation
Pesticide Use Proposal	Review of proposal and EPA registration by authorized certified applicator.	Prior to any herbicide application	Proposal compared to EPA registration requirements and ROD compliance
Water Monitoring Samples	Pre and post treatment water samples when program is near potable sources and could get into water.	As needed	Potential water contamination
Coordination Monitoring	Weed management plans submitted to Washington D.C.	Yearly	Coordination of plan
Biological Establishment	Survey of biocontrol agents release and establishment	State/District yearly	Establishment, effectiveness, and rate of spread of biological control agents.
Threatened and Endangered Surveys	Survey for T&E species prior to action	Each project	Presence of T&E species
Cultural Resource Surveys	Survey for archeological and historical resources	Each project which involves surface disturbance	Presence of cultural resources

Appendix 1-4. Key Sections of 1992 *Record of Decision on the Western Oregon Program - Management of Competing Vegetation Environmental Impact Statement*

The Decision

In managing competing and unwanted vegetation, the BLM's Decision is to combine features from the eight original alternatives to implement integrated vegetative management, emphasize a preventive strategy, reduce reliance on herbicides, and maintain the flexibility to potentially use all available treatment options in western Oregon. The Decision provides western Oregon-wide program guidance for the vegetation management program in a manner that is flexible for addressing site-specific variables occurring in the resource areas in the Cascade, Coastal and Klamath Provinces in western Oregon.

The BLM has given considerable analysis to the formulation and selection of the Decision features, weighed the risks associated with its implementation against the risks and severity of possible adverse impacts, evaluated public comments, consulted with professionals including accredited toxicologists, analyzed the process involving the USFS mediation document and their implementation guide, solicited public input on the FEIS, and released a draft ROD for public review and comment.

As the FEIS provided, the Decision combines features from the original alternatives in the FEIS, identifies a vegetative management process, specifies project design features and mitigating measures. The Decision emphasizes planning and monitoring, employing a preventive strategy, and reducing reliance on herbicide use.

Important distinctions specific to this approach are as follows:

- A judicious approach to vegetative management through systematic (sequential) program and site-specific planning and analysis where vegetation manipulation is expected to be needed.

- Development of action thresholds for plant communities with the intent of defining conditions that trigger potential needs for corrective treatments, anticipating competition problems, and assisting in monitoring activities. Involves verifying appropriate thresholds for local conditions and effectiveness of the prescription and techniques.

- A specified limit on yearly potential herbicide acreage available to reduce reliance on herbicides.
- Pursuit of adequate funding to make alternative treatments feasible.

- Recognition that herbicides, their formulations, and application techniques vary widely in their potential health effects, and that these decisions should be made on a site-specific basis with the risks of each method and their potential exposures being an important part of the Job Hazard Analysis and risk assessment.

A cap is placed on herbicide treatment in western Oregon in any one year; it will not exceed 8,800 acres. This Decision will retain the current emphasis for the BLM to continue its search for nonchemical methods of vegetative management when control is needed.

Another important part of the Decision is the acceptance of the qualitative risk assessment of BLM Appendix L done by the University of Washington (USFS 1988 FEIS, Appendix H), which was reserved in the FEIS until development of the Final ROD. Acceptance of the qualitative risk assessment signifies its incorporation into the FEIS and this ROD. This qualitative risk assessment addresses the quality of the data underlying the quantitative risk assessment.

The potential impacts of the Decision are within the scope of impacts discussed in the FEIS for the eight alternatives and the significant aspects of their environmental consequences.

Scope of the Decision

This FEIS and ROD apply to all BLM-administered land in the Coos Bay, Eugene, Medford, Roseburg, and Salem districts, and the portion of the Lakeview District previously within the Medford District prior to 1987. Further, the decision applies only to the portion of each activity that pertains to management of competitive and unwanted vegetation. Excepted from the decision is noxious weed control which is analyzed in a separate document, the Northwest Area Noxious Weed Control Program EIS (1986).

The Decision approach is to emphasize the use of prevention and natural processes to manage compet-

ing and unwanted vegetation. The decision applies to vegetation management planning and control activities, and sets guidelines and standard operating procedures for implementing such programs.

Treatment options available for consideration in the integrated management program include biological, manual, prescribed fire, mechanical, and chemical methods and techniques. In forest land management programs, these treatments are often essential for the establishment and maintenance of desired plants and for achieving good growth rates of desired vegetation to meet management goals. While controlling competition is key to both of these objectives, the manner in which adequate control of competitive vegetation is achieved varies. It is the variability, need, and manner of manipulation to ameliorate harmful competitive or unwanted vegetation that must be identified, analyzed and communicated on a site-by-site basis.

Planning and implementation of activities on a site-specific project basis will be done according to the NEPA process, and correlated with guidance set forth in this FEIS/ROD and approved land use plans. Site-specific projects may be planned and analyzed on either an individual or group basis.

General Provisions

The focus is two-fold: (1) To prevent or minimize the need for future vegetation management or corrective action and also subsequently the need for later treatments, and (2) To emphasize the use of preventive and natural processes.

The Decision is designed to protect human health and promote long-term productivity of the forest ecosystem while meeting the goals and objectives of management plans for such activities as timber production, habitat management, and maintenance of both transportation systems and recreation sites.

It combines a number of features from the eight original alternatives when corrective action is needed, minimizes impacts on air quality from prescribed fire, and reduces the potential for adverse human health effects.

To facilitate ongoing public involvement, the Decision provides for an interactive review of the vegetation management process throughout planning until project implementation. A public consultation process is also defined.

Guidelines for implementing the Decision are as follows:

- *Ecological relationships will be emphasized in designing program activities to meet land management objectives (such as timber harvest, roadside maintenance, wildlife habitat restoration).*

- *Human health risks to the public and workers will be evaluated to determine major design features.*

- *Where prevention is no longer a viable option, effective early treatment and alternatives to herbicides of special consideration are to be given priority.*

Vegetation Management Process

Definite steps recognized in the vegetative management process are as follows:

Step 1
Site analysis determines site conditions and potential needs for treatments according to objectives for the site.

Step 2
Strategies are evaluated to select the best planned course of action to implement a preventive approach, in the long term at a minimum.

Step 3
Project design for proposed treatment is developed which includes mitigating measures, public involvement, risk management, monitoring, and predicting of vegetation response.

Step 4
Vegetative management action implemented.

Step 5
Monitoring initiated to determine if course of action taken was effective and if further action is needed to promote the preventive approach.

Important Concepts to the Process

Concepts integral to the vegetation management process for the preventive approach include Integrated Pest Management, Prevention, Thresholds, and

Scheduling of Detection and Action as described in the following sections.

Integrated Pest Management (IPM)

"IPM is a systems approach to reduce pest damage (competitive and unwanted vegetation) to tolerable levels through a variety of techniques, including natural predators and parasites, genetically resistant hosts, environmental modifications and when necessary and appropriate, chemical pesticides." (BLM M-9220) For clarity, the decision expands the IPM definition in the FEIS glossary to reflect the generic definition. Further, for consistency, this definition will be used in all BLM western Oregon vegetation management planning and implementation.

IPM generally relies upon a combination of strategies, treatment options and techniques as preventive and corrective defense mechanisms against competitive and unwanted vegetation. When initiated early IPM can avoid vegetative management problems and, when needed, employ a variety of methods and techniques.

The BLM recognizes that the success of IPM is dependent upon several factors: knowledge of vegetative management strategies; a broad range of specific technical skills; planning, monitoring and implementing of multiple interactive steps over a fairly long time frame; potentially-high initial capital investments (e.g., mowers in roadside vegetative control); and consistent funding. Without the development of a vegetative community strategy, and without the planning that considers both single and sequential steps and treatment options, it is common for timing to be short between problem identification and action, and for there to be a lack of the available skills, workmonths, and funding to achieve the objectives. In the latter instances, and when unexpected situations occur, corrective or rescue actions are necessary to meet management objectives; IPM is then limited to selecting control alternatives or no action.

In view of the importance of an effective IPM program to the prevention strategy, the BLM will strive to have appropriate resources available. The BLM will encourage research on specific forest ecosystems and continue analysis on a site-by-site basis, linking these necessary steps to implement effective IPM programs and enable vegetative manipulation that avoids or reduces competitive and unwanted vegetation to acceptable levels. The BLM will also continue to support research towards gaining a thorough knowledge of the requirements of competitive and unwanted vegetation, and of the needs and vegetative growth characteristics of desired vegetation. Any actions that are similar or cumulative should ideally be anticipated during project planning stages and used to determine both the need and timing for control efforts under an IPM program.

Prevention Strategy

A key to implementing the Decision is the major emphasis on prevention as the priority strategy being accomplished through planning, to identify and take advantage of any situations where competitive or unwanted vegetation may not interfere with objectives, or to reduce the need for corrective actions.

In the context of the Decision, the term "prevention" will mean "to detect and ameliorate the conditions that cause or favor the presence of competing or unwanted vegetation in the forests. Prevention is in contrast to treatment, which refers to activities for controlling or eradicating infestations of competing or unwanted vegetation. It also should not be confused with early treatment, which refers to activities for controlling or eradicating existing, small infestations of competing or unwanted vegetation before they interfere with the agency's objectives for managing that area or adjacent lands." (USFS, Med. Doc., 1989.)

Emphasis is on prevention and then early action if action is needed. Other strategies include no action, correction, maintenance, and rescue and restoration. The potential for prevention or another strategy to achieve the goals for a given site will be analyzed prior to commencing any sequence of treatments.
The concept of prevention as a planned course of action in forest management has continued to develop and gain emphasis during the past decade as an accepted vegetative management strategy. It was a scoping issue in 1982 at which time it was proposed that such practices be considered under all alternatives and used whenever feasible.

Thresholds Concept

Determining damage and action thresholds is an important part of determining the need for action during the vegetation management analysis process. Thresholds are a measure of the degree or level of competition which depletes environmental resources to the disadvantage of a desired plant.

The appropriate timing of vegetation manipulation should involve determining both damage and action thresholds for control of competitive and unwanted vegetation. Damage thresholds refer to the levels of

vegetation abundance where there is a marked decrease in rate of the desired plants' survival and growth.

There appear to be two separate thresholds: one for tree survival and establishment, and another for growth maintenance and release. A survival damage threshold may have a competitive vegetation density level many times greater than the levels desired for optimal growth (free-to-grow), at least for short periods. Also, adequate growth often infers far less than that for "free-to-grow" status.

Because plant communities are a complex aggregation of plants and animals, the thresholds need to be identified and tested for efficacy and dose response at the plant community, or on a more localized level, and over various time periods including periods of drought and adequate moisture. Variance of floristics, dominance, growth habits, and succession from site-to-site may indicate a need for intensive vegetative control in some locations and during some time periods, yet very little control in other years and locations. Meeting the management objectives and maintaining forest health for one or more similar sites is the key to determining thresholds and selecting a vegetative management approach.

Determination of competitive thresholds give managers a better analytical approach in making choices about treatment need, treatment method, technique efficacy, and seedling performance on similar or comparable sites. It will also help determine the appropriate degree of tool intensity necessary to attain an expected level of plantation performance (Wagner et al 1989; Radosevich, et al 1990 New Zealand). To emphasize effective preventive strategies, the BLM will continue developing, modeling, testing, and evaluating appropriate thresholds for action on a plant or ecological community basis.

Scheduling of Detection and Action

Because planning is essential to the prevention strategy, it is necessary to document site evaluations, develop a time-line for the occurrence of expected problems if action is prescribed, and use a pretreatment survey to verify if action is expected to be implemented. Strategies such as planning to avoid certain competitive conditions, developing alternative silvicultural schemes, and taking early action will generally minimize damage and often preclude further treatment.

The time to detect and ameliorate unwanted or competitive vegetation conditions is early in the project planning stages, before growth loss of desired vegetation becomes serious, and before major corrective action is required. This determination of need can occur during regularly scheduled surveys, project analysis, and young stand monitoring.

Priorities

Based upon the foregoing, BLM establishes the following vegetation management priorities in selecting and designing treatment methods to achieve site-specific management objectives:

Priority 1 - Plan at the earliest opportunity to detect and ameliorate conditions that cause or favor the presence of competitive and unwanted vegetation. Also, review data from past treatments of comparable sites to determine potential need and treatment effectiveness.

Priority 2 - Search for, and use, effective nonchemical methods of vegetation control and selective treatments when feasible. Manipulate the potential vegetation and timing of any prescribed actions to attain the desired conditions and minimize the overall need for control of competitive vegetation.

Priority 3 - Use herbicides only after fully considering the effectiveness of all reasonable treatment options, combinations with various methods of manipulation, and herbicide environmental effects, safety, human health risks (exposure), specificity, effectiveness, and their relative costs of implementation. This includes reducing both use levels and exposures to herbicide by employing application techniques and efficient formulations to improve effectiveness and selectivity, minimizing size of treatment areas, and where feasible combining the herbicide option within a mix of other treatments and methods for a program of integrated pest management.

Because not all potential problems develop and many that develop do not reach a threshold level, it may be appropriate for managers to defer action on some units or portions of units to see if problems do develop or if the potential is serious. Generally, however, whenever treatment is needed it is best to take the earliest available action identified to maintain adequate conditions and growth for desired plants. The earliest action often is to manipulate or reduce the problem vegetation while that vegetation is small and easy to treat.

It may not always be necessary to collect new data to respond to issues and evaluate alternatives strategies. Applicable information may be found in existing site records, or from other comparable sites.

Herbicides Available for Use

When herbicides are considered, BLM could use formulations that contain one or more of the following herbicides: asulam, atrazine, 2,4-D, dicamba, glyphosate, hexazinone, picloram, and triclopyr. These herbicides were analyzed for use in the FEIS, and in Appendices D and H which are incorporated into the BLM's FEIS. Use of these chemicals is subject to special mitigation measures summarized in this ROD, and the guidance provided in the Herbicide Profiles.

The selection of herbicides to use, along with the guidance provided in this ROD, recognized that some data gaps exist (see Chapter 6). However, in general, the data gaps occurred where initial experiments did not meet current standards. Also, see Appendix D which was prepared to address data gaps.

Herbicide Formulations and Inert Ingredients

The BLM encourages the use of the least toxic inert ingredients available and requires the disclosure of data necessary to determine conditions of safety before a product can be used.

The reason for this precaution is that most chronic tests of herbicides do not use the full formula, but test only the active ingredient. A high proportion of these formulations have "inert" ingredients which often are neither chemically nor biologically inert and may have substantial toxicity themselves (see Appendix H).

Accordingly, only those formulations that do not contain inert ingredients on EPA's List 1 and 2 will be used, unless the risk associated with the listed inert ingredients is evaluated and the formulation found acceptable. In addition to considering EPA information to judge and select the least hazardous inert formulations available for use, BLM will use publicly available manufacturers' data and request acknowledgement about List 1 and 2 inert ingredients.

Two inert ingredients of concern—kerosene and diesel oil (both petroleum distillates)—have been reviewed by the BLM. It was determined that kerosene and diesel oil would not add significantly to the potency of the formulations. Their use will, however, be subject to the following guidelines:

- Kerosene will not be used in herbicide applications except as an inert ingredient in the formulations of 2,4-D (Esteron) and triclopyr (Garlon 4).
- Diesel oil will not be used in herbicide applications as a carrier; however, diesel oil may be used as an adjuvant (not to exceed five percent of spray mixture) (USFS, Region 6 FEIS).

Herbicide Use Restrictions and Precautions

An annual cap of 8,800 acres is placed on herbicide use during the effective life of this FEIS to reduce reliance on herbicides. Herbicides will be used only when other methods are ineffective, or will increase project cost unreasonably. This decision does not infer that herbicides are ineffective or costly. Rather, this decision to limit herbicide use arises from a concern among many people, including professionals, about the use of herbicides.

Further, when selecting a herbicide, the BLM will use only those herbicides for which herbicide profiles are, or will be, available.

Although markedly less toxic than insecticides, herbicides must be handled and applied with care. This need for caution is the reason that EPA registers herbicides, the BLM conducts risk analyses for program and public risk and worker job hazard analysis on site-specific projects. Another precautionary measure in the use of herbicides is that the personnel involved in planning, applying, supervising, and reviewing herbicide applications must be certified.

Precautionary measures BLM will employ relative to all herbicide use include conducting periodic literature reviews by accredited toxicologists, providing information sheets for each of the herbicides approved for consideration, strictly adhering to label regulations, and thoroughly training its applicators in safety precautions as well as proper application technology.

Specific protective measures for herbicide use are provided in Chapter 5 and Appendix B. It should be recognized that further review may show that expanded use of herbicides is justified, or that further prudence is appropriate.

Herbicides of Special Consideration

Due to their known or uncertain adverse human health effects the herbicides 2,4-D, asulam, and atrazine will be placed in a Special Consideration Category requiring special precautions, consideration and analysis whenever they are proposed for use. This will include ensuring that all feasible effective alternatives are considered and protection measures such as aerial

restrictions, worker protection and posting and controlling access have been implemented. (See the section on Effectiveness of Practice in Meeting Objectives for a related discussion on selection of herbicides of special consideration.)

Asulam, atrazine and 2,4-D have either incomplete or highly conflicting information about their human health effects. All three have cancer potency values noted in the FEIS, as if they are associated with or are carcinogenic, and recent toxicological data continue to recommend a cautious and conservative approach. Atrazine has controversial and potentially high risk reproductive MOS values, especially for workers and is a confirmed ground water contaminate.

Due to the above, the application technique and placement of atrazine and 2,4-D will require additional controls. A risk management strategy for the public and a job hazard analysis for workers will be developed to assure high risk exposures do not occur.

Program Implementation

Program Design

Implementation of the vegetative management program has two parts: standard operating procedures and project design features. The standards are a list of important measures that are applied on a regular basis for the various types of vegetation treatment. Project design features are intended to ensure the proper and safe implementation of treatment methods, and are selected based upon site-specific analysis. Analysis of specific treatment areas may result in modification of the project design features, or the identification of others, to provide adequate protection to nontarget organisms and human health. Standard operating procedures are listed below, followed by a list of common project design features.

Standard Operating Procedures

Strategy

Use prevention and natural processes as the preferred strategy to manage competing and unwanted vegetation. Conduct planning and monitoring to anticipate, and take steps to avoid, potential vegetation management problems. When needed, plan corrective actions to occur early and timely as compatible with a long-term preventive strategy and natural disturbance and recovery pattern in the site-specific area.

Safety

Always consider the safety of both the general public and workers. This includes determining the degree of exposure, hazard and risk posed by various vegetation management treatment methods for forestry workers, forest users, and nearby residents.

Program-wide risk assessment will be conducted by the program leaders prior to any treatment where there is potential for direct or indirect effects on human health to evaluate human health exposure to any hazardous substances and injuries. Keep in mind that this preliminary analysis is about generalities, not site-specific instances. Low-risk or low exposure methods will be sought for implementation to minimize public exposure to injurious situations.

In general, the risk assessment process will involve three evaluation components: Hazard, Exposure, and Risk. These components and their interrelationship are described below:

Hazard Evaluation: Identify harmful characteristics of the proposed vegetation management methods.

Exposure Evaluation: Estimate the kinds and levels of exposure and doses likely to result from potential exposures under routine, worst case, and accidental scenarios.

Risk Evaluation: Combine hazard information with dose level exposures to predict the health effects under the given conditions of exposure.

These evaluations are conducted for two groups of people: the general public and the occupationally exposed. A Job Hazard Analysis (JHA) is used to anticipate site-specific human health effects. For the general public, evaluation is done for single exposures and exposures over a 30-year time period.

When considering potentially harmful situations in site-specific evaluations, estimate exposure by identifying: (1) who is being exposed, (2) when the exposure will occur, (3) where exposure would occur, and (4) the amount, duration, and frequency of exposure. These estimates should then be compared to the average conditions found in the FEIS risk assessment and used to determine design and adequacy of mitigating measures.

The "amount" of exposure is the actual quantity or level of a substance that comes in contact with an individual. "Duration" is length of contact, and "frequency" is the number of encounters with the substance. Other

factors to consider in exposure analysis include proximity (distance) to human habitation, water source, or potential food stuffs, and recreation use patterns, weather conditions, and access to site.

All employees active in vegetation management will be trained in the safe use of prescribed fire, cutting tools and equipment operation, herbicides, and other techniques. Proper protective clothing will be worn by employees as prescribed in use manuals for methods such as chemicals and fire (BLM Manual H-1112-1).

The project design of prescribed fire will include consideration of such measures as smoke management, reduction, avoidance, and scheduling to protect recreationists and rural residents from smoke exposure (see Appendix B).

Information packets containing data on the potential hazards of chemical treatment methods will be made available to employees, the public, and contractors (see Appendix B and Herbicide Profiles, Appendix C). As new data becomes available, the information packets will be supplemented.

Worker Protection, Public and Occupational Accident/Incident and Illness Reporting

All workers who use or are exposed to hazardous tools/equipment including herbicide applications will utilize protective clothing and equipment that meet the specifications of the BLM Safety Manual, labels approved by the Environmental Protection Agency (EPA), and/or BLM risk analysis. (See worker protection in BLM Manual 9022; Manual Handbooks 1112-1, Chapters 14-16; and H-9011-1.)

A Job Hazard Analysis will be used for monitoring the impacts on human health. In addition an incidents-accidents system will be used for reporting employee, contractor, volunteer and public. In addition to injuries and illnesses, the system will be used to report vehicle accidents, property damage and fire losses (485 DM, Chapter 7 and BLM H-1112-1). Forms CA-1 and/or CA-2 for occupational exposure or injury and DI-134 for all reported accidents, incidents, and illnesses will be used.

The Report of Accident/ Incident (DI-134) will be used additionally to report health effects associated with vegetation management projects for forwarding to the Program Coordinator to be entered the Safety Management Information System (SMIS), reported to OSHA and used internally for trend analyses. The Federal Record System retains records for any employees exposed to toxic substances or harmful physical agents for 30 years (29 CFR Ch XVII 1910.20). Contractors will be required by stipulation to complete a DI-134 for each employee. The DI-134 along with the Project Accomplishment Report (herbicide use report) will list date of project work, specific assignments, herbicide formulation (if any) and ingredients used, safety or health hazards, and any health complaints.

Public Involvement

Determine the need or level of public involvement by reviewing the type of management actions. BLM management actions are divided into five categories (Manual 1790-1):

- Exempt from NEPA. Includes Congressional, emergency and rejected proposals.
- Categorical exclusions. Specifically identified actions, not restricted by exceptions list, that do not require an environmental assessment (EA).
- Actions already covered by an existing FONSI and EA, or EIS. Timber sales and multi-year EA. (Noxious weed control is in a separate EIS.)
- Actions covered by an EIS and require an EA.
- Actions that require an environmental impact statement.

Public involvement is to be encouraged and facilitated in vegetation management environmental analyses. The level and degree of public involvement will depend on public interest, type of analysis performed, and the method of treatment proposed.

The BLM will provide public notice whenever a site-specific project is considered to prevent or treat competing or unwanted vegetation with any proposed measure of treatment. (Excepted are actions exempt from NEPA or covered within a categorical exclusion.)

Public notice will precede the screening stage of the environmental analysis of the project under NEPA guidelines. Notification methods will include, at a minimum, a notice in local newspapers. Additional standard methods may include posting of public notices in the state office, district office and resource areas; and in other public rooms used to distribute public information concerning proposed Bureau actions. Notification lists maintained by the program

coordinators will be used in notifying the interested public of any proposed use of herbicides.

In case of an action with effects primarily of local concern, the notice may include: areawide clearing-houses, notices to potentially interested community organizations, direct mailing to owners and occupants of affected property, and posting of notice on and off site in the area where the action is located. The level of controversy will determine the need for notices and posting. Herbicide use areas will be posted. Notices must indicate procedures for interested persons to get information or status reports.

The public will be notified of the availability of the EA and FONSI (Finding of No Significant Impacts additional to those not already analyzed in a program's EIS). The manager responsible for authorizing the action determines the appropriate means of public notification and ensures its availability based on the extent of concern and interest in the action. All individuals or organizations that have requested notification on a specific action should be notified by mail where feasible. When considering the use of herbicides of special consideration the potential use will be made known to the public at the earliest practical time.

Before a decision is made to proceed with controversial treatment methods such as herbicides, the public will be invited to review and comment on the site-specific analysis of the project. When a decision is made for a site-specific project the public will be promptly notified of the final decision whether it is to proceed, or not to proceed.

Environmental analysis and public involvement will normally occur as indicated in four levels of project screening:

1. Screen unit for need of action, and set priorities. Where: Reforestation of timber sales or wildfire areas. Actions where no herbicides are proposed for use and the proposed treatment qualifies for categorical exclusions. Examples of current categorical exclusions:
   - Precommercial thinning
   - Manual maintenance and release.
   - Paper mulching and spot scalping.

2. Screen for need and complete environmental analysis. (Outside exclusions or controversial.)
   - Mechanical site preparation

3. Screen for need, complete environmental analysis, inform downstream water users.
   - Biological and grazing methods.

4. Screen for need, complete environmental analysis, inform downstream water users, notify adjacent property owners, provide public notification when there is a probable public exposure, and request response from those individuals who are hypersensitive. This screening should be done when proposing projects for herbicides and prescribed fire to determine appropriate risk management measures.

Considerations for public involvement when proposing vegetative management, regardless of type of treatment, is summarized on Table 5-2.

Project Design Features

Review site-specific conditions to determine which of the following project design features are needed.

Notify Private Landowners and Downstream Water Users

Residents and adjacent landowners within 0.5-mile of proposed treatment sites who likely could be directly affected by chemical drift, smoke, food or water contamination, or an accidental spill will be notified prior to any chemical, broadcast burning, or biological application, and actions will be taken to minimize any potential effects.

Minimum Width Buffer Strips

District guidelines as well as State water quality standards will be met by using buffer strips, contractual stipulations on method and techniques, and other site-specific criteria. Concerns to consider in planning and selecting a vegetative management strategy, treatment, or technique and in determining site-specific project design include stream bank stabilization, sediment rates, temperature, sensitive vegetation and other organisms, and bacteria counts. Buffer strips will meet resource management plan criteria and site-specific conditions.

When herbicides are used, the minimum buffer strips listed below will be reserved adjacent to class I and Important Class II (BLM order III and above) streams, lakes and ponds, pasture and agricultural lands. These minimum buffers will be in accordance with current interim protection requirements of the Oregon State Forest Practice Act requirements and definitions, or as specified on the herbicide use label.

Minimum Buffer Widths for Waterways When Herbicides are Proposed for Use

Application Technique	Minimum buffer Width
Manual wipe-on	High water mark
Manual	10 feet
Vehicle	50 feet
Aerial (Flowing stream)	100 feet
Aerial (Lakes and ponds)	200 feet

Applications of atrazine, a persistent chemical, in areas having shallow water tables or where aquifers are located in alluvial deposits along major streams, will be subject to guidelines for above-ground waterway buffers.

For mechanical and burning treatments, the minimum buffer along streams will be 25 feet.

Residences, Domestic Water Diversions and Agricultural Areas

Minimum buffer strips near residential, domestic water, and agricultural areas is determined by the site-specific application technique.

For aerial application of herbicides in areas adjacent to residences, a minimum buffer strip measuring at least 600 feet wide will not be treated unless a written waiver is provided by the landowner. For domestic water diversions in a drainage where aerial herbicide application is used, the minimum buffer will be 200 feet. Additional risk (exposure) assessment may be required for aerial herbicide treatment within 600 feet of a residence.

Aerial application of herbicides of special consideration (e.g., 2,4-D, asulam and atrazine) will be prohibited within 0.25-mile (1,380 feet) of residences.

For ground applications of herbicides, the minimum untreated buffer reserved between treatment areas and residences will be 100 feet.

Local conditions may require an expansion of the minimum widths. Some examples of site-specific factors that may necessitate additional buffer width include mode of transport (direct application, drift, and water flow), adjacent topography, buffer vegetation structure and functions, and nearby agricultural areas or gardens.

Other Sensitive Conditions

Buffer strips may also be recommended for wildlife habitat, scenic corridors, and other concerns as identified in land use plans.

Monitoring and Evaluation

Monitoring of the western Oregon vegetation management program will be done in accordance with established BLM procedures as provided for in BLM Manual H-1734-1, land use plans, and as indicated below. The need and type of monitoring will be dictated by the nature of critical components in the site-specific treatment area.

General guidelines for monitoring are as follows:

- Monitoring is to be done annually at both the program-wide and site-specific basis, and for worker and human health concerns. The Program Coordinators will: (1) project three-year estimates of proposed methods and techniques, (2) describe whether management actions are making satisfactory progress toward meeting objectives to reduce reliance on herbicides and meet prescribed fire air quality goals, and (3) present criteria for meeting goals.

- Site-specific post-treatment monitoring will be conducted to aid future planning, and at a minimum will include:

  -Efficacy of treatment or no treatment.
  -Costs, both direct and indirect.
  -Analysis of mitigating measures, unintended effects, and accidents.
  -Estimate of degree of success.
  -Assessment of both short and long-term effects on vegetation.

- Water Quality monitoring will be conducted per goals in land use plans to meet or exceed Best Management Practices guidelines. Monitoring of the spray operation will be conducted to determine if mitigating measures are being observed, are effective in maintaining water quality, and are in compliance with state water quality standards and herbicide label requirements. The potential for contamination of aquifers used by fish, or for municipal water or irrigation, will be considered in site-specific environmental assessments.

- The program-wide assessment will consider:

  -How well strategy is meeting management objectives (site preparation, seedling survival, improving wildlife habitat, roadside maintenance). Include "no action" locations in comparisons.

  -Whether assumptions are correct and potential impacts are as expected.

  -Effectiveness of mitigating measures.

  -Impacts on other resources (i.e., wildlife, water, air).

  -How projected need for herbicide and prescribed fire treatments can be reduced.

  -Consistency with federal agencies, state and local governments.

  -New data that would require alteration of program.

- Recording and reporting human health concerns would be done to verify job hazard analysis and risk assessments and would include review of:
  -Exposure incidence.
  -Accidents.
  -Worker health complaints.
  -Recording of treatment methods, including for herbicides: the exact identity, formulation, manufacture, mixture and method of application.
  -BLM Herbicide (Pesticide) Application Record, and worker and public Reports of Accidents/Incidents or Illnesses (DI-134, CA1 or CA2) for vegetative management projects.
  -Names of personnel working on herbicide projects, their assignments and dates of actual work (29 CFR XVII, 1910.20)

- The Program Coordinator will be incorporate any new data that would require alteration of the program.

- Conduct young stand monitoring during standard stocking survey at intervals of one, three, and five years and record treatment effectiveness, or as a post treatment evaluation survey on a sampling basis to be filed with BLM Project Implementation (Herbicide Application) Records.

- Submit annual report to Oregon State and Washington Offices for herbicide usage describing the acreage, amount, usage, location, and use strength for each chemical used. Retain project records for three years.

The above monitoring, along with planning and providing "no action" units or portions of units will help to determine effectiveness and need for action as a baseline comparison. Through these actions, the BLM will be able to determine if the actions are giving the desired management results.

Appendix 1-5. State Director Guidance for the RMP Process

According to Bureau regulations for preparing RMPs, "the State Director shall provide quality control and supervisory review, including plan approval, for plans and related environmental impact statements and shall provide additional guidance, as necessary, for use by District and Area Managers." "Guidance" means "any type of written communications or instructions that transmits objectives, goals, constraints or any other direction that helps District and Area Managers and staff know now to prepare a specific resource management plan."

Early in the process of concurrently preparing this RMP and five other RMPs which together cover all BLM-administered lands in western Oregon, the BLM State Director decided to develop comprehensive procedural guidance as planning criteria to assure consistent treatment of a variety of issues and concerns in the six plans. The intent to do this was conveyed to known interested parties in a mailer sent out by each BLM district office with planning responsibility on March 27, 1987. Suggestions for content of that guidance were solicited in the mailer.

There was limited public response, but that response, along with internal BLM recommendations, led to formulation of a proposed set of topics for State Director guidance. A mailer describing those topics were sent to the public for comment on August 11, 1987. Using further but still limited public comments, BLM modified its list of topics slightly and drafted Proposed State Director Guidance, which was sent out for public review by interested parties on May 13, 1988.

Although less than a hundred individuals and groups responded, many of the comments received were thoughtful and constructive, and addressed the proposals in depth. BLM undertook a substantial revision of many sections of the proposed guidance. This revision was done on a staggered schedule, to distribute the workload and provide timely guidance to the districts for each step in the process.

The first element of the guidance completed was Guidance for the Preparation of the Analysis of the Management Situation (AMS). This document summarizes important information about existing resource conditions, uses and demands, as well as about management activities and natural relationships. It provides the baseline for subsequent steps in the planning process, such as the design of alternatives and analysis of environmental consequences. The AMS also provides most of the data to be summarized in the "affected environment" chapter of the EIS. The AMS guidance prescribed minimum contents and table formats for the AMS for each plan. That guidance was essentially completed in October 1988, and slightly revised during 1989 and 1990.

A master glossary for the AMS was prepared as part of the State Director Guidance. It was completed in 1989, and later revised for inclusion in each Draft RMP.

The Guidance for Formulation of Alternatives was essentially completed in October 1990 but underwent modest revision during 1991 and 1992. A copy of the final version of this guidance is included in this appendix.

Two other sections, Guidance for Analytical Techniques Needed to Estimate Effects of Alternatives and Guidance for Use of the Completed Plan, were completed in July 1991, with slight modification of the former in 1992. Descriptions of complex analytical techniques have been appendicized to discussions of the relevant analyses in Chapters 3 and 4. The Use of the Completed Plan section was wrapped into the equivalent section of Chapter 2 of the Draft RMP/EIS.

The original draft guidance had two other sections that never became final. Guidance for the Executive Summary was dropped because the State Director's staff prepared that summary. Guidance for expressing consistency with plans, programs and policies of other agencies was never formalized, as BLM staff worked with state agencies and county planners until the Draft RMP/EISs were almost complete, on ways to express such consistency.

Guidance for Formulation of Alternatives

Introduction

The purpose of alternatives is to identify a range of reasonable combinations of resource uses and management practices that respond to planning issues and provide management direction for all resources. Five common alternatives will be addressed in each RMP, to provide a consistent set of distinct choices among potential management strategies.

A no change from the existing land use plan alternative will also be addressed. This is the "no action" alternative. In the other alternatives all existing land use decisions not found valid for continued implementation after 1990 (through an analysis summarized in the Analysis of the Management Situation), will be reconsidered.

Common alternatives that identify specific management actions along District boundaries will be consistent. Examples include elk management areas, spotted owl corridors or visual corridors.

This Guidance for Formulation of Alternatives may be modified later based on information identified in the districts' analyses of the management situation, or refinements that flow from the districts' site-specific development of common alternatives.

Goals and Objectives of the Common Alternatives

The purpose of the goal and objective statements for the five common alternatives (A through E) is to guide development of specific criteria. Each alternative, if implemented, is intended to achieve or meet its goal. Goal and objective statements focus on general direction of alternatives rather than technical points in issue-related criteria for the alternatives. In each alternative all resource management values would be accommodated to the extent consistent with the primary goals and objectives for that alternative.

Specific Guidance on Common Alternatives

The common alternatives would differ primarily in the way they allocate primary uses of lands (for example, lands allocated to intensive forest management, and lands allocated to protection of riparian zones).

The discussion on page 4 through part of pages 14 and 15 describes criteria for addressing each of the eleven planning issues in the formulation of the common alternatives. It also describes how land use allocations and management actions would vary in response to each issue. Within the specific constraints provided by the guidance for addressing each issue, the districts have flexibility to formulate the common alternatives as they consider appropriate to meet the goals and objectives of each alternative.

	Alternative A	Alternative B
GOALS:	Emphasize high production of timber and other economically important values on all lands to contribute to community stability.	Emphasize timber production to contribute to community stability consistent with the variety of other land uses such as fish and wildlife habitat, recreation, and scenic resources on O&C and CBWR lands. Give equal consideration to all resource values on public domain lands.
OBJECTIVES:	• Produce the highest sustained yield of timber on all suitable forest lands legally available for harvest. • Contribute to ecological functions important to timber productivity and to habitat diversity to the extent possible consistent with the allocation for timber production. • Manage threatened and endangered species habitat as legally required. • Provide Research Natural Areas and eligible Areas of Critical Environmental Concern to the extent consistent with the allocation for timber production. • Manage appropriate Congressionally designated areas to maintain and enhance their scenic values. • Meet legal requirements for protection of wetlands and water quality, to protect anadromous fish habitat and other relevant values. • Emphasize substantial developed and dispersed motorized recreation uses. • Find no additional rivers suitable for designation under the Wild and Scenic Rivers Act. • Make land tenure adjustments which enhance BLM long-term sustained yield timber harvest opportunities. • Provide no special management in rural (residential) interface areas.	• Produce a high sustained yield of timber on O&C and CBWR lands, and on public domain lands where nontimber uses and values are of lesser importance than timber production. • Contribute to ecological functions important to timber productivity and to habitat diversity using a system that maintains old growth and mature forest in large and small blocks. • Protect habitat of all threatened and endangered species and species with high potential for listing. Protect habitat of other species of substantial concern to the extent consistent with high timber production. • Retain existing Research Natural Areas (RNAs) and Areas of Critical Environmental Concern (ACECs). Provide new ones from eligible areas to the extent consistent with the emphasis on timber production. • Manage scenic resources in selected areas of high recreation use. • Meet legal requirements for protection of wetlands and water quality and provide moderate additional protection for anadromous fish habitat, other substantial streams, and other water. • Provide for a wide range of developed and dispersed motorized recreation uses and opportunities, to minimize conflicts among recreation user groups. • Find eligible river segments suitable for designation as recreational, if they are important and manageable, and designation would not cause adverse economic impact. • Make land tenure adjustments which enhance BLM long-term sustained yield timber harvest opportunities on O&C and CBWR lands, and which benefit a variety of uses and values on public domain lands. • Adopt appropriate special forest management practices on BLM-administered lands intermingled with or adjacent to rural interface areas zoned for most dense residential occupancy.

Alternative C

Provide timber production to contribute to community stability consistent with maintenance of biological diversity and the variety of other uses such as fish and wildlife habitat, recreation, and scenic resources on all lands.

- Produce a moderate sustained yield of timber.
- Provide biological diversity using a system that maintains some old growth and mature forest, focusing on protection of areas where special status plant and animal species cluster.
- Protect habitat of all threatened and endangered species and species with high potential for listing. Protect habitat of other species of substantial concern through emphasis on biological diversity and to the extent consistent with moderate timber production.
- Retain existing RNAs and ACECs. Provide new ones from eligible areas except where lands managed by others are considered to provide more appropriate opportunities.
- Manage scenic resources in selected high use areas, particularly emphasizing protection in corridors of existing and proposed wild and scenic rivers and major trails.
- Provide substantial protection for anadromous fish habitat, other substantial streams and other water environments.
- Provide for a wide range of recreation opportunities emphasizing dispersed use, while reducing conflicts among recreational user groups.
- Find eligible river segments suitable for designation as scenic or recreational, if they are important and manageable, but not suitable for designation as scenic if designation would cause adverse economic impact.
- Make land tenure adjustments to benefit a variety of uses and values.
- Adopt appropriate special forest management practices in rural interface areas zoned for moderate or high density residential occupancy.

Alternative D

Emphasize protection and reestablishment of spotted owl habitat, along with management and enhancement of other values such as dispersed nonmotorized recreation opportunities and scenic resources, while sustaining some timber production.

- Produce a sustained yield of timber consistent with allocations for other uses and values.
- Protect habitat of the spotted owl in accordance with the Owl Conservation Strategy.
- Protect habitat of all threatened and endangered species, species with high potential for listing, and species of related concern.
- Retain all existing RNAs and ACECs. Provide new ones from eligible areas except where lands managed by others are considered to provide more appropriate opportunities.
- Manage all identified scenic resources.
- Provide substantial protection for wetlands and riparian areas along most streams and other water.
- Emphasize dispersed nonmotorized recreation opportunities.
- Find eligible river segments suitable for designation as wild, scenic or recreational, if they are important and manageable.
- Make land tenure adjustments which would emphasize enhancement of nontimber uses and values.
- Adopt special timber harvest and forest management practices in rural interface areas zoned for moderate or high density residential occupancy.

Alternative E

Emphasize protection of older forests and management and enhancement of values such as dispersed nonmotorized recreation opportunities and scenic resources.

- Produce a sustained yield of timber consistent with allocations for other uses and values.
- Protect all old growth and older mature forests.
- Protect habitat of all threatened and endangered species, species with high potential for listing and species of related concern.
- Retain all existing RNAs and ACECs and designate all eligible areas.
- Manage all identified scenic resources and provide some visual resource protection for all lands.
- Manage all riparian areas and wetlands to maintain and improve water quality and fisheries habitat, and contribute to wildlife habitat diversity.
- Emphasize dispersed nonmotorized outdoor recreation opportunities.
- Find all eligible river segments suitable for designation as wild, scenic or recreational rivers.
- Make land tenure adjustments which would emphasize enhancement of nontimber uses and values.
- Adopt special timber harvest and forest management practices extensively buffering rural interface areas zoned for moderate or high density residential occupancy and other rural interface areas as appropriate.

	All Common Alternatives	Alternative A
Issue No. 1: Timber Production Practices: Which forest lands should be available for timber management, and what practices should be used on those lands?	Guidance for All Common Alternatives: Lands allocated to intensive forest management under any of these alternatives would normally provide the highest nondeclining harvest level (even flow) of timber when the following conditions prevail: • Effective silvicultural techniques (such as clear cutting, shelterwood or partial cutting) appropriate to the land allocations are used. • All feasible site preparation and intensive management practices are applied. • Anticipated merchantability is the only constraint on minimum average stand diameter slated for future harvest. (In some areas this may result in harvest of timber stands as young as 40 years for several decades during the early to middle part of the next century under some alternatives.) • Adequate budgets are available to support the resultant timber sale program and allied intensive management practices, as well as scheduled monitoring linked to those activities. The common alternatives assume these practices and conditions on the lands allocated to intensive timber management, but incorporate less intensive management practices on other available forest lands to the extent needed to be consistent with the allocation of those lands. Where consistent with the goals and objectives of each alternative, the following silvicultural and harvest practices would be implemented on lands allocated primarily to timber management, to meet multiple land use objectives: Minimize regeneration delay by reforesting harvested sites as soon as practical. Calculate an empirical regeneration period based on representative stocking survey results, expected timber sale contract lengths and management objectives. Reforest harvested lands with indigenous commercial tree species. Emphasis would be placed on utilization of genetically improved stock in accordance with the Western Oregon Tree Improvement plan. Manage tree seed orchards to produce adequate supplies of genetically improved seed. Use available site preparation and seedling protection practices, including herbicides, using an integrated vegetation management approach. Emphasize those techniques that have proved most effective in assuring seedling survival and growth. (Actual practices will be based on site-specific analysis following completion of the RMP.) Convert to conifers those lands classified as commercial forest lands presently occupied by grass, hardwoods and brush.	Allocate all forest lands for timber production consistent with the management direction for other resources (Issue Nos. 2 and 3, etc.) in this alternative, except the following: Nonsuitable Woodland (See Figure 1-E-1 for Chart showing TPCC categories.)

Alternative B	Alternative C	Alternative D	Alternative E
Allocate all forest lands for timber production consistent with the management direction for other resources in this alternative, except the following: Nonsuitable Woodland Suitable Woodland - Low Site	Allocate all forest lands for timber production consistent with the management direction for other resources, except the following: Nonsuitable Woodland Suitable Woodland - Low Site Suitable Woodland - Nonsuitable Commercial Forest Land	Allocate all forest lands for timber production consistent with the management direction for other resources, except the following: Nonsuitable Woodland Suitable Woodland - All Categories	Allocate all forest lands for timber production consistent with the management direction for other resources, except the following: Nonsuitable Woodland Suitable Woodland - All Categories The Fragile Gradient-Restricted component of the Fragile Suitable TPCC category Site Class V

	All Common Alternatives	Alternative A
Issue No. 1 (Continued)	Plan hardwood sites for management of a sustained yield of hardwoods, where consistent with allocations for other uses or values. Implement commercial thinning of present and future stands where practicable and where research indicates increased gains in timber production are likely. Practice initial spacing control of seedlings/ saplings through planting or thinning in conjunction with the control of competing vegetation, to maximize wood production by concentrating site resources in individual tree growth. Plan nitrogen fertilization applications for all present and future stands where research indicates increased wood yields would result. Plant specific root disease centers with resistant tree species. Consider uneven-age management in stands where this method would be economically feasible and would maintain environmental values. Consider efficiency of field operations and assurance of prompt reforestation in selecting the size of timber harvest units. Apply proper soil management measures to maintain soil productivity.	
Issue Nos. 2 and 3: Old-Growth Forests and Habitat Diversity To what extent and where should old-growth and/or mature forest habitats be retained, maintained or reestablished to meet various resource objectives? To what extent and where should BLM manage habitat to support populations of native wildlife species?	Any wildlife habitat management practice (such as nest boxes, road closures and forage seeding) not listed in the following could be implemented under any of the alternatives, as long as it is compatible with other management objectives. All special habitat features would be managed to protect their values. Mature and old-growth forests would be retained where Congressional designation of areas requires it. Snags and/or wildlife trees (to be converted to snags) would be retained where they occur on lands not allocated to timber harvest, except where public safety is a concern, and if left standing as nonmerchantable material on available forest lands. Where it would contribute to meeting wildlife tree objectives, create snags in areas not allocated primarily to timber production. A habitat goal of timber sale contracts would be to leave all snags and nonmerchantable trees that can be left consistent with safety considerations.	Mature and old-growth forests would be retained on most lands excluded from planned timber harvest by inclusion in the following allocations and TPCC categories: Nonsuitable Woodland Riparian Management Areas Existing high-use recreation sites T&E species recovery areas where timber harvest is prohibited Wilderness Areas

Alternative B	Alternative C	Alternative D	Alternative E
Contribute to habitat diversity using a system that protects mature and old-growth forest in large and small blocks. Mature and old-growth components of the forest would be distributed in a corridor system by seed zone and elevation. In the corridor system large blocks of approximately 640 acres would be connected by a series of small, stepping stone blocks of approximately 80 acres, spaced at about one-mile intervals. Blocks would be limited to defined corridor areas. Public Domain lands and the following allocations and TPCC categories on O&C and CBWR would receive priority for placement into the system, to the extent that they fit; for instance, if they provide needed habitat and are suitably located to contribute to the system. Nonsuitable Woodland Suitable Woodland - Low Site Riparian Management Areas Recreation Sites T&E species recovery areas where timber harvest is prohibited Special Areas (Natural Areas, ACECs) Wilderness Areas	This alternative would provide for retention and improvement of biological diversity. Blocks of forest land at least 600 acres in size and, where relevant opportunities exist, at least 2500 acres in size (including cornering tracts) would be identified as old-growth restoration and retention areas, totalling 15 to 20 percent of BLM-adminstered forest land. Identification of these areas would focus on protection of older forest stands, connectivity between larger reserves and subregions, and protection of identified areas where special status plant and animal species cluster. The remaining BLM-administered forest lands, not excluded from timber harvest to address other issues, would be subject to intermediate harvests for density management where feasible, to maintain open canopy conditions and promote retention of mixed species, as well as accelerate development of old-growth structure conditions and prepare the stands for regeneration harvest	This alternative would manage habitats on BLM-administered lands to provide for a number and distribution of spotted owls that ensures continued existence of a well distributed population on those lands, so they may interact with spotted owls throughout the geographic range of the species, as recommended by the Conservation Strategy for the Northern Spotted Owl. Suitable wildlife trees would be retained to contribute to the maintenance or attainment of cavity-dweller populations on BLM-administered lands at 60 percent of the optimum woodpecker population level. Wildlife tree and down log management practices would be used on the available forest lands, including but not limited to retention of green culls, snags and down logs. All special habitat features would be appropriately buffered.	This alternative would preserve the following: - all existing forest stands over 150 years old. - additional lands within 400 feet of the above stands, to assist in maintaining natural ecological elements, protect the older stands from edge effect and natural disaster, and interconnect them into a sustainable network. - all suitable habitat forest stands which most closely match the lands within two miles of each spotted owl site occupied by a single or pair of owls in the last six years (1985-1990). In addition protect younger forest where needed to provide contiguous habitat within a mile of those sites. - in each section where BLM administers at least half of the land, a 40-acre block of the oldest stands remaining, concentrated around headwaters streams, to provide habitat for amphibians and nesting for pileated woodpeckers.

	All Common Alternatives	Alternative A
Issue Nos. 2 and 3 (Continued)		
Issue No. 4: Threatened and Endangered (and Other Special Status) Species Habitat What should BLM do to manage Federally listed threatened or endangered plants and animals and to prevent future Federal listing of plants and animals as threatened or endangered species?	Protect, monitor and manage habitats of Federal listed and proposed species in accordance with the Endangered Species Act and recovery plans, as legally required for self-sustaining survival.	Timber production constraints would be assumed in the formulation of the alternative only if critical habitat has been designated or there is a recovery or conservation plan within a month after completion of the Analysis of the Management Situation. Manage for the conservation of, and mitigate actions to protect habitats of, Federal Candidate, State Listed and Bureau Sensitive species where such actions would not diminish commercial use such as timber production.
Issue No. 5: Special Areas What areas on BLM-administered lands need special management to prevent irreparable damage to important historic, cultural or scenic values; to protect botanical or fish and wildlife resources or other natural systems or processes; and to protect life and safety from natural hazards? Which of these areas should be formally designated as Areas of Critical Environmental Concern (ACEC)?	Any areas considered appropriate for Research Natural Area (RNA) designation would also be considered appropriate for ACEC designation.	Designate potential ACECs that meet criteria only if the relevant values are not protected by other authorities (e.g., Wild River designation, the Endangered Species Act). Existing ACECs and potential ACECs that meet the preceding standard, including RNAs and proposed RNAs, would be retained or designated on nonforest lands or nonsuitable woodlands of no substantial mineral potential. Other existing ACECs and RNAs would be revoked.

Alternative B	Alternative C	Alternative D	Alternative E
Suitable wildlife trees and/or snags would be retained to maintain, where possible, cavity-dweller populations at 40 percent of the optimum woodpecker population levels in new timber harvest units. Wildlife tree management practices would be used on the available forest lands, including retention only of green culls and snags.	in the future. Regeneration harvests on these lands would be either heavy partial cuts (green-tree retention) or group selection cuts, and would not occur until after a stand had established old-growth characteristics. The lands in old-growth restoration and retention areas, which have not attained old-growth characteristics, would be subject to similar density management, where feasible, until they attain such a condition. Suitable wildlife trees would be retained to contribute to the maintenance or attainment of cavity-dweller populations on BLM administered lands at 60 percent of the optimum woodpecker population level. Wildlife tree and down log management practices would be used on the available forest lands, including but not limited to retention of green culls, snags and down logs. All special habitat features would be appropriately buffered.		In addition to retention of wildlife trees on lands not allocated to timber management, suitable wildlife trees would be retained to contribute to the maintenance of cavity-nester populations at 60 percent of the maximum potential population level on lands allocated to timber management. Wildlife tree and down log management practices would be used on the available forest lands, including but not limited to retention of green culls, snags and down logs. All special habitats would be appropriately buffered.
Same as Alternative A, except protect habitats of Federal Candidate, State Listed and Bureau Sensitive Species to the full extent on public domain land, and protect habitats of Federal Candidate (i.e., Category 1 and 2) species known only to occur on BLM-administered lands to the extent considered necessary to prevent their federal listing.	Same as Alternative B except for additional protection of special status species provided by criteria for Issues 2 and 3.	Manage all BLM-administered lands to support the conservation and protection of all Federal Candidate, State Listed, and Bureau Sensitive species and their habitats.	Same as Alternative D.
Retain all existing ACECs and RNAs. Designate potential ACECs that meet criteria only if the relevant values are not protected by other authorities. Do not allocate new RNAs on available O&C or CBWR land if a similar feature can be protected on a National Forest. Designate all potential ACECs (including RNAs) on Public Domain lands, nonforest lands, nonsuitable woodlands, and other lands allocated to nontimber uses.	Retain all existing ACECs and RNAs. Designate potential ACECs that meet criteria only if the relevant values are not protected by other authorities.	Retain all existing and designate all potential ACECs.	Same as Alternative D.

	All Common Alternatives	Alternative A
Issue No. 6: Visual Resources Which, if any, areas of BLM lands should be managed to reduce visual impacts or enhance visual (scenic) quality?	Note: Guidance for Issue 11 (Rural Interface Area Management) also addresses and defines visual resource management for Alternatives B, C, D and E in rural interface areas, except where this Issue 6 guidance sets a higher standard of visual resource management. Guidance for Issue 9A (Wild and Scenic Rivers) establishes criteria that will substantially dictate visual resource management by alternative in proposed wild and scenic river corridors. See Issue 9A and Issue 11 guidance for details.	Provide VRM Class I management within existing boundaries designated by Congress for exclusive management. Manage all other available (for timber harvest) forest land under VRM Class IV management objectives. Manage other lands as inventoried.
Issue Nos. 7 and 8: Stream/Riparian/Water Quality Where and how should riparian zones be managed to protect and improve water quality, fisheries and wildlife habitat? What actions should be undertaken to comply with state water quality standards? What should BLM do to manage for special needs such as municipal and domestic use?	Guidance for All Common Alternatives: Establish Riparian Management Areas (RMAs) on perennial streams (generally, 3rd order and larger streams), lakes, ponds and other waters, to meet Oregon Forest Practices Act requirements and Oregon water quality standards. Typical average widths of RMAs by alternative are displayed in Table 1. Within those RMAs no lands would be considered "available" (to offer timber for sale as part of the allowable sale quantity). Some timber harvest may occur, however, to achieve resource management objectives. These activities may include road construction and yarding corridors across streams and riparian zones to facilitate timber harvest outside the RMA. Logging, road building and site preparation methods would be designed to minimize the number and/or size of mass soil movements and to maintain the integrity of the RMAs. Other activities such as mining, recreation and ORV use would be regulated to protect water quality. Stream and riparian habitat improvement measures may be taken on any streams to improve water quality, fish habitat and/or wildlife habitat. Activities would be designed to meet Oregon Forest Practices Act (OFPA) requirements and Oregon water quality standards. Protect wetlands in accordance with Executive Order 11988 and 11990. Comply with written agreements with public water systems serving municipalities.	
Issue No. 9: Recreation Resources What areas or sites should be designed and/or managed to protect or enhance a variety of recreational opportunities?	Manage for dispersed recreation activities consistent with managed forest settings, including hunting, fishing, sightseeing, riding/hiking, and rafting. Maintain and manage existing recreation facilities which make available significant dispersed recreation opportunities, including recreation sites, boat ramps, trails, interpretive signs and related improvements. Manage existing Special Recreation Management Areas (SRMAs) and delineate Extensive Recreation Management Areas (ERMAs).	Manage existing high-use recreation sites and trails and expand them where needed. Close low use recreation sites and trails. Designate lands open to off-road vehicles (ORV) and leave roads open to motorized use, except where such designation would conflict with other allocations.

Alternative B	Alternative C	Alternative D	Alternative E
Provide VRM Class I management within existing boundaries designated by Congress for exclusive management. Manage as inventoried all available forest land adjacent to (within a quarter mile) developed recreation sites, state and federal highways, state scenic waterways, and rivers designated under the federal Wild and Scenic Rivers Act. Manage all other available forest land under VRM Class IV management objectives. Manage other lands as inventoried.	Same as Alternative B, except on available forest land where BLM-administered land makes up more than half of a viewshed, manage lands as inventoried.	Manage all lands as inventoried.	Same as Alternative D, except manage as VRM Class III all BLM-administered lands inventoried as Class IV; and manage as VRM Class I BLM-administered lands adjacent to (within a quarter mile) developed recreation sites, state and federal highways, state scenic waterways and rivers designated under the federal Wild and Scenic Rivers act.

Table 3-1. Riparian Management Areas

Stream Order	Average RMA Width* (each side of the stream in feet) ALT. A	ALT. B	ALT. C	ALT. D	ALT. E
1					50
2				60	60
3	75	75	105	140	200
4	75	100	150	200	200
5	75	140	210	280	280
6	75	160	240	320	320
Lakes, Ponds & Other Waters	75	100	150	200	400

* Actual RMA widths would be determined by on-the-ground riparian vegetation, terrain and stream characteristics, but would be a minimum of 50 feet on all 3rd order and larger streams. First and second order streams would have RMAs designated if perennial or if the beneficial uses warrant.

Alternative B	Alternative C	Alternative D	Alternative E
Same as Alternative A, except support the State's Regional Economic Development Plan for the geographic area, retain options for new SRMAs and high value potential recreation sites and trails on Public Domain lands, maintain and/or improve all existing developed recreation sites, and consider reopening sites closed in recent years.	Allocate and manage new SRMAs. Continue management of all existing recreation sites and trails, and consider reopening sites closed in recent years. Emphasize wildlife viewing, interpretation and related old-growth forest recreation opportunities, both to attract nonlocal visitors and to serve local users. Retain options for future development of high value potential sites, trails and sightseeing opportunities. Impose additional ORV limitations or road closures to protect wildlife habitat or old-growth forest recreation opportunities, minimize conflicts with hikers and horseback riders, or meet other resource objectives.	Same as Alternative C, except manage for an optimum range of nonmotorized recreation. Retain options for future development of recreation sites and facilities for dispersed recreation opportunities. Retain existing pockets of old-growth forest that are both adjacent to and accessible from existing or potential recreation areas. Prohibit ORV and road use as appropriate to improve wildlife habitat or protect the ecosystem.	Same as Alternative D.

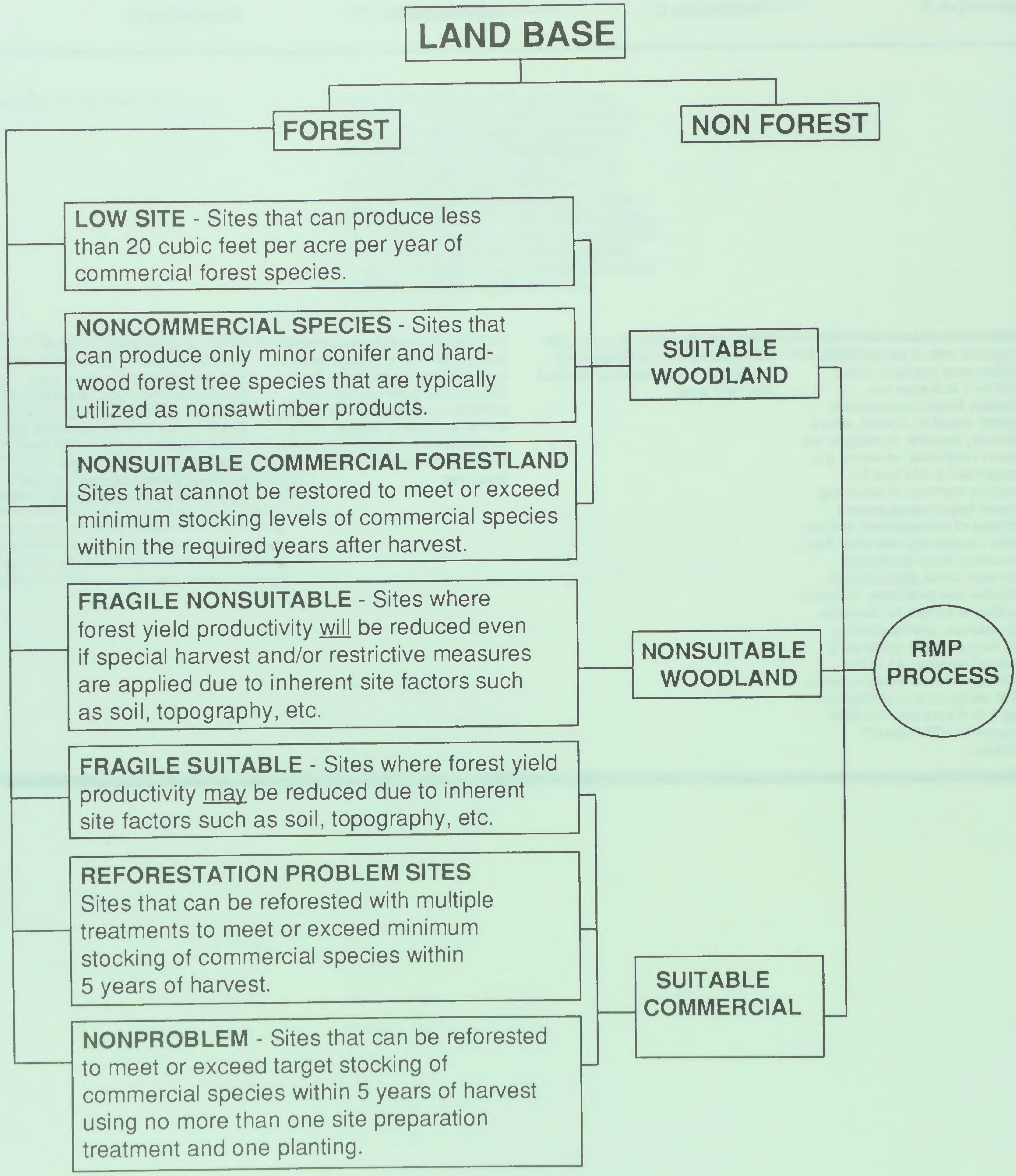
	All Common Alternatives	Alternative A
Issue No. 9A: Wild and Scenic Rivers What, if any, rivers should be found suitable for designation?	Provide interim protection for all river segments determined to be suitable, until Congressional action on BLM plan recommendations. Interim protection should be appropriate to the highest category for which the river is determined to be suitable. Manage Congressionally designated rivers consistent with their designation.	No rivers found suitable for designation under any classification.
Issue No. 10: Land Tenure In what areas would BLM-administered lands be sold, exchanged or transferred out of federal ownership under other authorities to improve management efficiency and benefit resource program objectives? In what areas would BLM attempt to acquire lands to improve management efficiency and benefit resource program objectives?	A major lands program effort would use exchanges to consolidate land ownership patterns to benefit one or more of the resources managed, such as timber, watershed, wildlife habitat, recreation, cultural, botanical, and minerals. Land tenure adjustment would be guided by a three-zone concept utilizing the following standards: Zone 1 includes areas currently identified as having high public resource values, and other efficiently managed lands. The natural resource values may require protection by federal law, Executive Order or policy. These lands may have other values or natural systems which merit long term public ownership. They do not meet the criteria for sale under FLPMA Section 203(a) and would generally be retained in public ownership. The Zone 1 boundaries should be relatively close to or on BLM property lines except where the intent is to show preferred acquisition areas. Zone 2 includes lands that are suitable for exchange because they form discontinuous ownership patterns, are less efficient to manage than Zone 1 lands, and may not be accessible to the general public. Where appropriate opportunities are identified, these BLM-administered lands may be exchanged for other lands in Zones 1 or 2, transferred to other public agencies, or given some form of cooperative management. These lands would not be expected to meet the criteria for sale under Section 203(a), and would not be identified as suitable for such sale. Zone 3 includes lands that are scattered and isolated with no known unique natural resource values. Zone 3 lands are available for use in exchanges for private inholdings in Zone 1 (high priority) or Zone 2 (moderate priority). They are also potentially suitable for disposal through sale	Exchanges would be made to acquire lands which would enhance the nondeclining harvest level of the commercial forest land managed by BLM, by improving age class distribution or other harvest level determination factors. Factors to consider include site quality, access to public forest land, logical logging units, and management of public forest land to facilitate timber harvest. No exchanges would be made to acquire lands more valuable for nontimber uses. No commercial timberland would be sold or leased. Leases or conveyance of land in Zones 2 and 3 other than commercial timberland would be made under the Recreation and Public Purposes Act to provide appropriate facilities or services.

Alternative B	Alternative C	Alternative D	Alternative E
No rivers found suitable for designation as wild or scenic. River segments eligible for wild, scenic or recreational classification found suitable for designation as recreational, if all of the following circumstances exist: - no net adverse economic impacts on the local economy. - river segment possesses at least one outstandingly remarkable value for which it is considered by BLM to be the top river in the State Comprehensive Outdoor Recreation Plan (SCORP) region. - BLM can effectively manage the outstanding values of the river segment.	River segments eligible for scenic or recreational river status found suitable for designation consistent with their highest potential classification, and river segments eligible for wild classification found suitable for designation as scenic, if all of the following circumstances exist. If only the economic impact test is not met, find suitable for designation as recreational. - no net adverse impacts on the local economy. - river segment possesses at least one outstandingly remarkable value for which it is considered by BLM to be among the top two rivers in the SCORP region. - BLM can effectively manage the outstanding values of the river segment.	Eligible river segments found suitable for designation consistent with their highest potential classification if the following circumstances exist. - river segment possesses at least one outstandingly remarkable value for which it is considered by BLM to be among the top four rivers in the SCORP region. - BLM can effectively manage the outstanding values of the river segment.	All eligible river segments found suitable for designation consistent with their highest potential classification.
Exchanges of O&C and CBWR lands would be made primarily to acquire lands which would enhance timber management opportunities. Exchanges of public domain lands would be made to benefit one or more of the resources managed, including nontimber values. Sale of O&C and CBWR lands other than available commercial forest lands, and of public domain lands, would be made to dispose of lands that meet any of the criteria of FLPMA Section 203(a). Leases on such lands would be made to accommodate other uses. Leases or conveyances under the Recreation and Public Purposes Act would be made in Zones 2 and 3 to provide appropriate facilities or services.	Same as Alternative B, except emphasis would also be given to exchanges of O&C and CBWR lands that would contribute to conservation of biological diversity.	Land exchanges would be made to benefit one or more of the resources managed. Exchanges involving disposal of timber to acquire lands containing greater nontimber values would be emphasized. Sales of lands other than available commercial forest lands would be made to dispose of lands that meet criteria (1) or (2) of FLPMA Section 203(a), but sales of land that meet only criterion (3) would not be made. No lands would be leased, except leases and conveyances under the Recreation and Public Purposes Act would be made in Zones 2 and 3 to provide facilities or services for the benefit of the public.	Same as Alternative D.

	All Common Alternatives	Alternative A
Issue No 10. (Continued).	under FLPMA Section 203(a) if important recreation, wildlife, watershed, threatened or endangered species habitat, and/or cultural values are not identified during disposal clearance reviews and no viable exchange proposals for them can be identified. The discussion of Zone 3 lands must state which of the disposal criteria in FLPMA, Section 203(a), apply. Zone 3 lands would also be available for transfer to another agency or to local governments, as needed to accommodate community expansion and other public purposes.	
Issue No. 11: Rural Interface Area Management Which BLM-administered lands should be allocated to receive special management practices due to the concerns of residents who live in close proximity? (Rural interface areas are areas where BLM-administered lands are adjacent to or intermingled with privately owned lands where county zoning has created or allows for creation of lots as small as 1 to 20 acres. In most rural interface areas concerns of the residents are related to forest management practices, visual quality and potential affects on domestic water sources and water supplies.)		No special management actions except those that address other issues.

Alternative B	Alternative C	Alternative D	Alternative E
On BLM-administered lands within one quarter mile of private lands in identified rural interface areas zoned for 1 to 5-acre lots, customary forest management practices would be altered, where realistically feasible, to mitigate the adjacent neighbors' concerns (i.e., management would look for alternative methods of practicing intensive forest management). Examples of management options include harvest regimes other than clearcutting, hand application rather than aerial application of herbicides and pesticides, inclusion of additional buffers for domestic water sources, and hand piling slash for burning as opposed to broadcast burning. All BLM-administered lands within a quarter mile of designated rural interface areas 1 to 5-acre lots) would be managed for VRM class III objectives.	Same as Alternative B except that lands zoned for 1 to 20-acre lots would also be included as the rural interface area.	On BLM-administered lands within one quarter mile of private lands in rural interface areas zoned for 1 to 20-acre lots, there would be no herbicide spraying, no clear cutting, and no prescribed burning. BLM-administered lands within this area would be managed for VRM class II objectives.	Same as Alternative D except BLM-administered lands within one half mile of private lands in rural interface areas would be managed as discussed in Alternative D. Areas zoned for lots larger than 20 acres, but with tax lots of 20 acres or less and/or existing legal multiple residences, may also be addressed in this alternative.

Figure 1-E-1



LAND BASE
FOREST
NON FOREST
LOW SITE - Sites that can produce less than 20 cubic feet per acre per year of commercial forest species.
NONCOMMERCIAL SPECIES - Sites that can produce only minor conifer and hard-wood forest tree species that are typically utilized as nonsawtimber products.
NONSUITABLE COMMERCIAL FORESTLAND Sites that cannot be restored to meet or exceed minimum stocking levels of commercial species within the required years after harvest.
FRAGILE NONSUITABLE - Sites where forest yield productivity will be reduced even if special harvest and/or restrictive measures are applied due to inherent site factors such as soil, topography, etc.
FRAGILE SUITABLE - Sites where forest yield productivity may be reduced due to inherent site factors such as soil, topography, etc.
REFORESTATION PROBLEM SITES Sites that can be reforested with multiple treatments to meet or exceed minimum stocking of commercial species within 5 years of harvest.
NONPROBLEM - Sites that can be reforested to meet or exceed target stocking of commercial species within 5 years of harvest using no more than one site preparation treatment and one planting.
SUITABLE WOODLAND
NONSUITABLE WOODLAND
SUITABLE COMMERCIAL
RMP PROCESS

Sensitivity Analyses

Sensitivity analysis is a process of examining specific opportunity costs and trade-offs which would result from making changes in single sensitive elements of an alternative. Such analyses are helpful in developing the preferred alternative, to make it most effective in reconciling potential conflicts and optimizing overall benefits. The sensitivity analysis will have the further benefit of informing the public about certain trade-offs, which should facilitate their offering informed preferences in their comments on the Draft RMP/EIS.

Because of the number of issues, concerns and alternatives, sensitivity analysis must be tightly focused to be manageable. The analysis, therefore, will focus on mid-range common alternatives and the preferred alternative.

At a minimum, the following will be analyzed for effects on timber harvest (ASQ) and related jobs and county revenues, and on other relevant resources or values:

1. For alternatives B, C and D, effects of substituting the next higher and next lower common alternative levels of riparian zone protection, and of providing only legally required (Alternative A) protection of riparian zones to preserve commercial trees on suitable forest or woodland. For the preferred alternative, the effects of substituting the alternative A and E levels.

2. For Alternative B, the effects of allocating no lands specifically for maintenance of older forest stands; or of managing the lands allocated for such protection on 250-year or longer rotation, with explicit provision for replacement; or of managing the lands allocated for timber production on 150-year rotation.

3. For Alternatives B and C, the effects of managing all lands allocated for timber production entirely under either of alternative C's partial retention approaches.

4. For Alternative C, the effects of managing the lands allocated for timber production entirely for 15 to 20 percent partial retention, but in the first decades not harvesting in the oldest 20 percent of them.

5. For Alternatives B and D, the effects of substituting the USF&WS proposed spotted owl recovery plan for each alternative's older forest or spotted owl protection approach. For the preferred alternative, to provide a similar analysis, the effects of substituting the 50-11-40 rule for provision of connectivity by special management in Connectivity Areas.

6. For Alternative C, the effects of allocating the restoration and retention blocks to 35+ percent partial retention management, or of accelerating density management in those blocks in the first decade to the extent practical.

7. For Alternative D, the effects of a minimum harvest age constraint of 60 years (vis-a-vis 40 years in D in many plans).

8. For the preferred alternative:

   - The effects of precluding all timber harvest in old growth ecosystem areas.

   - No regeneration harvest of stands younger than cumulation of mean annual increment.

   - No constraint on minimum age of stands subject to regeneration harvest in General Forest Management Areas.

   - Foregoing planting genetically selected stock, vegetation management for release and precommericial thinning, fertilization, and stand conversion. To be analyzed for each practice individually and for all combined.

Other sensitivity analysis elements or increments may be added as deemed appropriate by a district.

Estimated effects on ASQ, together with resulting local employment and county revenues for each analysis, will be quantified. Effects on other resource attributes will be quantified only where available analytical techniques are readily applicable. Otherwise, effects will be compared to relevant environmental consequence conclusions for the basic plan alternatives.

Chapter 2 Appendix

Appendix 2-1
Best Management Practices

Introduction

This appendix has two major sections: Best Management Practices (BMP); and Timber Production Capability Classification (TPCC) Fragile Code Guidance. The BMPs described in this document are designed to achieve watershed objectives of maintaining or improving water quality and soil productivity. The recommended practices listed in the TPCC Fragile Code Guidance section are restrictive or mitigation measures necessary to avoid unacceptable soil productivity loss for lands classified as fragile-suitable, restricted. The goal of all the practices listed is to either prevent or mitigate adverse impacts while meeting other resources objectives.

The BMPs are a compilation of existing policies, guidelines and commonly employed practices to minimize water quality degradation and loss of soil productivity. Appropriate BMPs are selected by an interdisciplinary team on a site specific basis to meet management goals. The implementation of these BMPs will be the beginning of an iterative process that includes the monitoring and modification of BMPs. This process is considered the primary mechanism to achieve Oregon State Water Quality Standards.

This appendix is designed to ensure compliance with the:

Clean Water Act of 1987. Section 310 requires that the states determine those waters that will not meet the goals of the act, to determine those nonpoint source activities that are contributing pollution, and develop a process of determining eight BMPs to reduce such pollution to the "maximum extent practicable". The Bureau of Land Management has been named a "designated agency" to carry out those provisions including the determining BMPs.

Oregon Administrative Rules (Chapter 340, Section 340-41) Department of Environmental Quality (DEQ). These rules contain water quality standards for the identified beneficial uses of water in relation to the antidegradation policy, the requirement for the highest and best control of waste activities, temperature and turbidity.

Best Management Practices

I. Timber Harvest

A. Timber Sale Planning and Design.

Objectives: Use the planning process to ensure that timber sales are designed to maintain favorable conditions of soil productivity, water flow, and water quality for the beneficial uses in the watershed.

Practices:

1. Design RMAs to meet the criteria set in the preferred alternative.
2. Use timber production capability classification (TPCC) to identify areas classified as nonsuitable for timber production.
3. Use TPCC and field investigations to identify areas classified as fragile suitable, restricted.
4. Use the planning process to identify, evaluate and map potential problems (e.g. slump prone areas, saturated areas and slide areas). Design appropriate preventive measures.
5. Design proposed harvest units to avoid, mitigate, or minimize potential adverse impacts to soil and water. Evaluation factors include the following: soil characteristics, watershed physiography, current watershed and stream channel conditions, proposed roads, skid trails and logging system design.
6. Plan mitigation measures if adverse impacts to water quality/quantity or soil productivity may result from the proposed action.
7. Analyze watershed cumulative effects and provide mitigation measures if necessary to meet water quality standards.

8. Disperse activities over time and space.

9. Include on timber sale maps and/or contracts the location of all stream channels and wetlands (spring, meadows, lakes, bogs, etc.)

10. Location of fragile (nonsuitable and suitable) areas that require special management Practices.

11. Include on timber sale maps and/or contracts the location of protection required for each stream channel, wetland, and fragile area.

B. RMA Protection

Objectives: To prevent damage to riparian ecosystems and disturbance to streambanks, protect the natural flow of streams and preserve nutrient cycling from woody debris.

Practices:

1. Allow no mineral lease operations, chemical loading operations or similar toxic pollutant activities within 200 feet of all water bodies.

2. Directionally felled trees to protect streams/RMA when harvesting within a tree length of any stream/RMA.

3. All snags in the RMA would be left except where safety or fire hazard dictate removal

4. Nonmerchantable down logs, including trees or logs down prior to logging, would be left in the RMA; all down logs would be left in stream channels.

5. No skid trails would be placed in the RMA except at designated crossings.

6. Avoid locating landings within 50 feet of RMAs.

7. Avoid disturbance of unstable banks and headwalls.

8. Restrict use of tractors in and adjacent to water.

9. Avoid yarding through RMA s when possible.

10. Restrict yarding in RMAs to corridors which are perpendicular to streams. Management guidelines for corridors where practical are:

- Restrict corridors to a minimum number.

- Where possible, corridors will not exceed 50' in width nor reduce crown cover on a project stream segment to less than 75 percent of predisturbance conditions.

- Logs will be fully suspended over water and adjacent banks. If full suspension is not possible, logs will be at least one end suspended.

11. Avoid removal of down trees of logs in stream channels and RMAs.

12. Remove excessive concentrations of logging slash from all streams prior to fall rains and place above high water mark.

13. Remove all logging slash in streams (resulting from the current timber sale) for a distance of 100 feet above culverts. Place slash above high water mark.

C. Yarding Methods.

Objectives: To minimize loss of soil productivity and reduce potential for surface runoff and subsequent degradation due to surface disturbance or compaction.

Practices:

1. Cable.

   a. Use partial suspension when yarding on erodible or ravel prone areas, where practical.

   b. Use full suspension when yarding on fragile soils, where practical.

   c. Use seasonal restriction if appropriate suspension cannot be achieved by yarding equipment.

   d. Avoid downhill yarding where practical.

e. Hand waterbar cable yarding corridors immediately after use according to guidelines in Section IV.D.1. on sensitive soils (Category 1) where gouging occurs.

2. Ground-based

a. Use existing skid roads wherever possible.

b. Limit new skid trails to slopes less than 35 percent.

c. Use designated skid roads to maintain compaction levels of skid roads plus landings at less than 12 percent.

d. Restrict tractor operations to these trails and limiting operations to periods of low soil moisture, when soils have the most resistance to compaction (dry season).

e. In partial cut areas, locate skid roads so that they can be used for final harvest.

f. Till all compacted trails, including skid trails from previous entries, with a properly designed self-drafting winged subsoiler.

g. Avoid tractor yarding on areas where soil damage cannot be mitigated due to physical conditions.

h. Avoid placement of skid roads through areas of highwater tables or where the skid roads would channel water into unstable headwall areas.

i. When needed, waterbar skid roads to minimize erosion.

j. Avoid use of wide track vehicles or more than one machine on a skid road at any given time to minimize the width of the skidroads. (On multiple pass skid roads, wide tract vehicles result in wider skid roads, and after multiple passes, drive the compaction deeper than a regular width track; however, they are good for one pass operations such as incidental scattered salvage or site preparation).

k. Leave large downed woody debris on site.

l. Rip existing tractor skid trials prior to felling timber with a properly designed winged subsoiler.

II. Roads

A. Planning

Objective: To plan road systems in a manner that meets resource objectives and minimize resource damage.

Practices:

1. Use an interdisciplinary process to develop an overall transportation system.

2. Establish road management objectives that minimize adverse environmental impacts given the use of the road.

3. Avoid fragile and unstable areas or plan appropriate mitigation measures.

4. Minimize the percent of the land base converted to roads and landings; avoid heavy concentrations of roads and landings to minimize impacts from increased peak flows and erosion of the compacted surfaced.

B. Location

Objectives: To minimize mass soil movement, erosion and sedimentation.

Practices:

1. Locate roads out of riparian management areas (RMA) where practical alternatives exist.

2. Locate roads on stable positions (e.g. ridges, natural benches, and flatter transitional slopes near ridges and valley bottoms). Implement extra mitigation measures when crossing unstable areas is necessary.

3. Avoid headwalls whenever possible.

4. Avoid construction on unstable areas where practical.

5. Locate roads to minimize heights of cuts. Avoid high, steeply sloping cuts in highly fractured bedrock.

6. Locate roads on well-drained soil types.

7. Locate stream crossing sites where channels are well defined, unobstructed and straight.

C. General Design Features

Objective: To design the lowest standard of road consistent with use objectives and resource protection needs.

Practices:

1. Road design standards and design criteria are based on road management objectives such as traffic requirements of the sale and the overall transportation plan, an economic analysis, safety requirements, resource objectives, and the minimization of damage to the environment.

2. Consider future maintenance concerns and needs when designing roads.

3. Preferred road gradients are 2-10 percent with a maximum grade of 15 percent. Consider steeper grades in those situations where they will result in less environmental impact. Avoid grade less than two percent.

4. Outsloping - outsloping of the road prism for surface drainage is normally recommended for local spurs or minor collector roads where low volume traffic and lower traffic speeds are anticipated. It is also recommended in situations where long intervals between maintenance will occur and where minimum excavation is desired. Outsloping is not recommended on gradients over 8-10 percent.

5. Insloping - insloping of the road prism is an acceptable practice on roads with gradients over 10 percent where the underlying soil formation is very rocky and not subject to appreciable erosion or failure.

6. Minimize excavation through the following actions whenever possible: use of balanced earthwork, narrow road width, and endhauling where slopes are greater than 60 percent.

7. Locate waste areas suitable for depositing excess excavated material.

8. Endhaul waste materials generated during road and ditch maintenance if side slopes exceed 60 percent or where unacceptable environmental damage may occur.

9. End Haul excess materials where slopes have been over loaded.

10. Surface roads if they will be subject to traffic during wet weather. The depth and gradation of surfacing will usually be determined by traffic type, frequency, weight, maintenance objectives and the stability and strength of the road foundation and surface materials.

11. Provide for vegetative or artificial stabilization of cut and fill slopes in the design process. Avoid establishment of vegetation where it inhibits drainage from the road surface or where it restricts safety or maintenance.

12. Prior to completion of design drawings, field check the design to assure that it fits the terrain, drainage needs have been satisfied, and all critical slope conditions have been satisfied, and all critical slope conditions have been identified and adequate design solutions applied.

13. Avoid diverting water into headwalls — roll the grade to channel water away from headwalls — check maintenance on existing roads to ensure water isn't allowed to remain on the road and/or diverted into unstable headwall areas.

14. Unless a road is needed for continued resource management, use a temporary road and put it to bed after use, using methods such as blocking, ripping, seeding, mulching, fertilizing, and waterbarring.

15. Minimize potential erosion on a road — if unsurfaced, put it to bed; otherwise apply rock to minimize surface erosion.

16. Approve location of all landings and landing clearing limits prior to clearing.

17. Select landing locations on the basis of the least amount of excavation and erosion potential where sidecast will not enter drainages or damage other sensitive areas.

18. Avoid landing locations alongside or in meadows, or other wetland areas.

19. Restore the shape of landings back to the natural configurations or shape to direct the runoff to preselected spots where water can be dispersed to natural, well-vegetated, stable ground.

D. Design of Cross Drains

Objectives: To minimize concentrated water volume and velocity on the road prism, thus to reduce movement and sedimentation.

Practices:

1. Design placement of all surface cross drains to avoid discharge onto erodible (unprotected) slopes or directly into stream channels. Provide a buffer or sediment basin between the cross drain outlet and the stream channel.

2. Locate culverts or drainage dips in such a manner to avoid outflows onto unstable terrain such as headwalls, slumps or block failure zones. Provide adequate spacing to avoid accumulation of water in ditches or surfaces through these areas.

3. Provide energy dissipators or armoring at cross drain outlets or drain dips where water is discharged onto loose material or erodible soil or steep slopes.

4. Use the guide for drainage spacing by soil erosion classes and road grade shown in Table 1.

5. Consider using drainage dips in lieu of culverts on roads which have gradients less than 10 percent or where road management objectives result in blocking roads. Avoid drainage dips on road gradients over 10 percent.

6. Locate drainage dips where water might accumulate, or where there is an outside berm which prevents drainage from the roadway.

7. Cut all cannon culverts to the proper length, downspout, and provide for energy dissipation.

8. When sediment is a problem, design cross drainage culverts or drainage dips immediately upgrade of stream crossings to prevent ditch sediment from entering the stream.

9. Rolling gradients is a recommended design practice in errodible and unstable soils to reduce surface water volume and velocities ánd culvert requirements.

10. Consider use of slotted riser inlets on granitic and schist soils to prevent culvert plugging.

E. Design of Stream Crossings

Objective: To preclude streams crossings from being a direct source of sediment to streams thus minimizing water quality degradation and provide unobstructed movement for aquatic fauna.

Practices:

1. Pipe arch culverts are appropriate on most fishery streams. Bottomless arch culverts and bridges will be necessary in some instances where gradients greater than .5 percent, stream discharge and value of the fishery resource dictate that special engineering considerations are necessary to ensure uninterrupted fish passage. A round culvert is suitable for non-fishery streams since fish passage is not a concern in these instances.

2. Use the theoretical 50 year flood as design criteria for culverts with end area 35 square feet or greater. Use the theoretical 25 year flood as design criteria for culverts with less than 35 square feet end area.

3. Minimize the number of crossings on any particular stream.

4. Where feasible, design culvert placement on a straight reach of stream to minimize erosion at both ends of the culvert. Design adequate stream bank protection (e.g. riprap) where scouring would occur. Avoid locations that require stream channel to be straightened beyond the length of a culvert to facilitate installation of a road crossing.

5. Evaluate the advantages and disadvantages of a temporary versus permanent crossing structure in terms of economics, maintenance and resource requirements for access to the area during all seasons over the long tern.

6. Minimize the number of temporary crossings on a particular stream.

7. Low ford stream crossing is appropriate only when site conditions make it impractical or uneconomical to utilize a permanent or temporary crossing structure.

F. Construction

Objective: To create a stable roadway that will minimize soil erosion and water quality degradation.

Practices:

1. Limit road construction to the dry season (generally between May 15 and October 15). When conditions permit operations outside of the dry season, keep erosion control measures current with ground disturbance, to the extent that the affected area can be rapidly closed/blocked and weatherized if weather conditions warrant.

2. Manage road construction so that any construction can be completed and bare soil can be protected and stabilized prior to fall rains.

3. Confine construction of pioneer road to within the roadway construction limits.

4. Conduct pioneering so as to prevent undercutting of the designated final cutslope and prevent avoidable deposition of materials outside the designated roadway limits. Conduct slope rounding included in the design during the pioneering stage when the pioneer road cut slope is the same as the road backslope. This avoids excess amounts of soil being moved after excavation and embankment operations are completed.

5. Construct embankments of appropriate materials (no slash or other organic matter) using one or more of the following methods:

   a. layer placement (tractor compaction)

   b. layer placement (roller compaction)

   c. controlled compaction (85-90 percent maximum density).

6. Avoid sidecasting where it will adversely affect water quality or weaken stabilized slopes.

7. Place surface drainage prior to fall rains.

8. Clear drainage ditches and natural watercourses above culverts of woody material deposited by construction or logging prior to fall rains.

9. Confine major culvert installation to the period of June15 to September15 to minimize sedimentation and the adverse effects of sediment on aquatic life.

10. Divert the stream around the work area to minimize sedimentation effects downstream.

11. Install the culvert as close to zero percent slope as possible on fishery streams but not to exceed 0.5 percent. Place culverts on larger non-fishery streams in the streambed at the existing slope gradient. Energy dissipators (e.g. large rock) placed at the outfall of culverts on small non-fishery streams are recommended to reduce water velocity and minimize scour at the outlet end.

12. Countersink culvert 20 percent of culvert diameter below the streambed to minimize scouring at the outlet. Increase culvert diameters accordingly.

13. Confine activities by heavy equipment in the streambed to the area that is necessary for installation of the structure. Restrict construction equipment to within the approved right-of-way and out of the streambed.

14. Permanent stream crossing structures on fishery streams are recommended to be in place before heavy equipment moves beyond the crossing area. Where this is not feasible, install temporary crossings to minimize stream disturbance.

15. Place riprap on fills around culvert inlets and outlets where appropriate.

16. Where possible, limit the installation and removal of temporary crossing structures to once during the same year and within the prescribed work period. Install and removal should occur between June15 and September15 to minimize adverse effects of sediment on aquatic life.

17. Use backfill material that is as soil-free as practicable over temporary culverts. Whenever possible use washed river rock covered by pit run or one inch minus as a compacted running surface.
18. Spread and reshape clean fill material to the original lines of the streambed after a crossing is removed to ensure the stream remains in its channel during high flow.
19. Limit activities of mechanized equipment in the stream channel to the area that is necessary for installation and removal operations.
20. Remove stream crossing drainage structures and in-channel fill material during low flow and prior to fall rains. Reestablish natural drainage configuration.
21. Use washed rock/gravel in a low water ford crossing if it will be used much.
22. Rock the road approaches with 150 feet of each side of a low water ford to prevent washing and softening of the road surface.
23. Construct adequate waterbars on roads, spurs and skid trails prior to fall rains.
24. Use the following table for waterbar spacing, based on gradient and erosion class.

Table 1

Water Bar Spacing (in feet)

	Erosion Class		
Gradients (%)	**High**	**Moderate**	**Low**
3-5	200	300	400
6-10	150	200	300
11-15	100	150	200
16-20	75	100	150
21-35	50	75	100
36+	50	50	50

Spacing is determined by slope distance and is the maximum allowed for the grade.

G. Road Renovation/Improvement

Objective: To restore or improve a road to a desired standard in a manner that minimizes sediment production and water quality degradation.

Practices:

1. Improve flat gradients to a minimum of two percent or provide raised subgrade sections (turnpike) to avoid saturation of the road prism.
2. Reconstruct culvert catchbasins to specifications. Catchbasins in sold rock need not be reconstructed provided that culvert entrance specifications are met.
3. Identify potential water problems caused by off-site disturbanced and add necessary drainage facilities.
4. Identify ditchline and outlet erosion caused by excessive flows and add necessary drainage facilities and armoring.
5. Replace undersized culverts and repair damaged culverts and downspouts.
6. Add additional full-rounds, half-rounds and energy dissipators as needed.
7. Correct special drainage problems (i.e. high water table, seeps) that affect stability of subgrade through the use of perforated drains, geotextiles, drainage bays, etc.
8. Eliminate undesirable berms that impair drainage away from the road prism.
9. Restore outslope or crown sections.
10. Avoid disturbing backslope while reconstructing ditches.
11. Surface inadequately surfaced roads that are to be left open to traffic during wet weather.
12. Require roadside brushing be done in a manner that prevents disturbance to root systems (i.e. avoid using excavators for brushing).
    - Exposed soil would be seeded or protected when necessary to keep surface erosion within accepted standards.

- Install stabilization features such as debris racks, bin walls, and rock blankets as needed.

13. Reconstruct poorly built stream crossings with bridges or culverts, insuring proper alignment and grade.

H. Maintenance

Objective: To maintain roads in a manner which provides for water quality protection by minimizing surface erosion, rutting failures, sidecasting and blockage of drainage facilities.

Practices:

1. Provide the basic custodial required to protect the road investment and to ensure that damage to adjacent land and resources is held to a minimum.

2. Perform blading and shaping in such a manner as to conserve existing surface material, retain the orginal crowned or outsloped self-drainage cross section, prevent or remove rutting berms (except those designed for slope protection) and other irregularities that retard normal surface runoff. Avoid wasting loose ditch or surface material over the shoulder where it will cause stream sedimentation or weaken slump prone areas. Avoid undercutting of backslopes.

3. Keep road inlet and outlet ditches, catchbasins and culverts free of obstruction, particularly before and during prolonged winter rainfall. However, hold routine machine cleaning of ditches to a minimum during wet weather.

4. Remove slide material when it is obstructing road surface and ditchline drainage and either utilize for needed road improvement elsewhere or place in a stable waste area. Avoid sidecasting of slide material where it will damage, overload, or saturate embankments, or flow into downslope drainage courses.

5. Retain vegetation on cut slopes unless it poses a safety hazard or restricts maintenance activities. Accomplish roadside brushing by cutting vegetation rather than pulling it out and disturbing the soil.

6. Patrol areas subject to road damage during periods of high runoff.

7. Reclaim/revegetate all roads not needed for future management activities.

8. Exposed soil would be seeded or protected when necessary to keep surface erosion within accepted standards.

9. Stabilize major failures (landslides) by subsurface drainage, rock blankets, or other methods.

I. Road Closures

Objectives: To prevent erosion and sedimentation of streams from unmaintained roads, and restore site productivity to roads no longer needed.

Practices:

1. Barricade or block road surface using gates, guard rails, earth/log barricades, boulders, logging debris or a combination of these methods. Avoid blocking roads that will need future maintenance (i.e. culverts, potential slides, etc.) with unremovable barricades. Using guardrails, gates or other barricades capable of being opened for roads needing future maintenance.

2. Follow-up on road closures to ensure they are maintained in accordance with design criteria.

3. Install waterbars, cross drains, cross sloping or drainage dips if not already on road to assure drainage.

4. Till with a winged subsoiler, revegetate for erosion control and site productivity restoration.

K. Water Source Development

Objective: To supply water for road construction, dust abatement and fire protection while maintaining existing water quality and supply.

Practices:

1. Design and construct durable, long-term water sources.

2. Avoid reduction of downstream flow that would detrimentally affect aquatic resources, fish passage or other uses.

3. Direct overflow from water holding developments back into the stream.

4. Locate road approaches to instream water source developments in minimize potential impacts in the riparian zone. Rock surface these approaches to reduce the effects of sediment washing into the stream.

5. Avoid use of road fills for water impoundment dams unless specially designed for that purpose.

6. Construct water sources during the dry season (generally between May 15 and October 15).

J. Restoration of Rock Quarries

Objective: To minimize sediment production from quarries that are susceptible to erosion due to steep sideslopes, lack of vegetation, or their proximity to water courses.

Practices:

1. Wherever possible, prior to excavation of the site, remove and stockpile topsoil for surface dressing during the post-operation rehabilitation.

2. Stabilize pit sides and smooth the general pit area.

3. Use seeding, mulching and drainage to minimize erosion.

4. Rip, waterbar, block, fertilize and seed access roads to rock pits where no future entry is planned. Rehabilitate or restore quarries in this category to renewable resource levels.

III. Silviculture

A. RMA Protection

Objectives: To prevent damage to riparian ecosystems, disturbance to streambanks, deterioration of water quality and accumulation of slash in streams.

Practices:

1. No slashing within RMAs.

2. Directionally fell trees to protect RMAs when slashing within a tree length of any stream or RMA.

B. Mechanical Methods of Site Preparation

Objectives: To maintain soil productivity and water quality while meeting the silviculture objectives.

Practices:

1. Limit the use of tracked equipment that would cause unacceptable soil disturbances or compaction to areas of less than 30 percent slopes.

2. Do not compact skeletal or shallow soils.

3. Till all compacted areas with a properly designed winged subsoiler. This could be waived if inspection reveals that less than two percent of the area is compacted. Compaction of less than two percent is considered to equal less than one percent growth loss.

4. On sites which do not annually dry out enough to provide resistance to traditional tracked equipment, use low-ground-pressure, tracked-type excavators (including: backhoe/grapple/loader/slasher).

5. No piles or tractor operations within RMAs. No piles or tractors within 25 feet of RMAs or within 25 feet of 1st and 2and order streams.

6. Restrict tractor operations to dry conditions with less than 25 percent soil moisture content in the upper six inches of soil.

7. Avoid piling concentrations of large logs and stumps.

8. Pile small material (3-8" diameter size predominantly).

10. Burn piles when soil and duff moistures are high.

C. Chemical Methods

Objectives: To protect water quality from pollution, and to enhance solid productivity.

Practices:

1. Refer to vegetation Management EIS.

2. Avoid aerial application when wind speeds would cause drift.

3. Locate heliports and storage areas away from stream channels.

4. Restrict the application within 100 feet of perennial streams.

5. Avoid direct application to intermittent streams.

D. Broadcast Burning

Objectives: To maintain long term soil productivity, organic matter and duff, water quality, retain legacy, and to meet hazard reduction objectives.

Practices:

1. Evaluate need for burning based in soils, plant community and site preparation criteria. Burn under conditions when a light or moderate burn can be achieved (see guidelines below) on all units to protect soil productivity. The following standards should be followed.

   a. Category 1 Soils (highly sensitive). Avoid burning.

   b. Category 2 Soils (moderately sensitive). Reduce disturbance, fire intensity and duration by using the following methods:

      - Burn under conditions that result in low intensity fires.
      - Burn when soils and duff are moist.
      - Avoid burning sparsely vegetated areas on slopes greater than 65 percent.
      - Gross yard to break up heavy slash concentrations, and reduce burn intensities.
      - Pull slash and woody debris adjacent to landings onto landings before burning.

   c. Category 3 Soils (least sensitive). Write prescriptions to protect a large percentage of the nutrient capital and other beneficial properties in the soil and the forest floor. (Low and moderate intensity burns.)

2. No intentional burning within RMAs.

3. Firetrails.

   a. Construct tractor fire trails with one pass construction during periods of dry soil moisture.

   b. Where the fire trail construction has resulted in compacted surfaces, rip and waterbar the fire trail (use properly designed winged ripper).

   c. Avoid the placement of tractor constructed fire trails on slopes in excess of 35 percent.

   d. Avoid the placement of any fire trails where water would be channeled into areas of instability or headwalls.

   e. Waterbar all fire trails that may carry water to minimize surface erosion.

E. Thinning

Objectives: To protect soil productivity, water quality and riparian ecosystems.

Practices:

1. Refer to timber harvest.

IV. Other Activities

A. Firewood.

Objectives: To prevent erosion from road use and water quality degradation.

Practices:

1. Seasonal restriction on firewood cutting when access to cutting area is on an unsurfaced road.

2. Clean all road surfaces, ditches and catchbasins of debris from wood cutting.

B. Wildfire Control

Objectives: To minimize water quality degradation and maintain soil productivity while achieving rapid and safe suppression of wildfire.

Practices:

1. Limit use of heavy equipment near RMAs and on steep slopes when possible. Where fire trail entry into a RMA is essential, angle the approach rather than have it perpendicular to the RMA.

2. Attempt to keep fire retardant out of water sources.

3. Utilize information from burned area surveys to determine if watershed emergency fire rehabilitation is needed.

4. Develop a fire rehabilitation plan through an interdisciplinary process.

5. Select treatments on the basis of on-site values downstream values, probability of successful implementation, social and environmental considerations (including protection of native plant community), and cost as compared to benefits.

6. Examples of emergency fire rehabilitation treatments include: 1) seeding grasses or other vegetation as needed to provide a protective cover as quickly as possible; 2) mulching with straw or other suitable material; 3) fertilizing; 4) channel stabilization structures; 5) trash racks above road drainage structures; and 6) waterbars on firelines.

C. Watershed Rehabilitation and Fish Habitat Improvement Projects

Objectives: To mitigate and minimize damage to riparian vegetation, streambanks, and stream channels.

Practices:

1. Employ good project planning by an interdisciplinary team.

2. Use corrective measures to repair degraded watershed conditions and restore to predisturbance conditions with a vegetative cover that will maintain or improve soil stability, reduce surface runoff, increase infiltration, and reduce flood occurrence and flood damages.

3. Carefully plan access needs for individual work sites within a project area to minimize exposure of bare soil, compaction and possible damage to tree roots. Utilize existing trails to the extent practical.

4. Confine work in the stream channels to between June15 and September15 to minimize the area of the stream that would be affected by sedimentation during the low flow period.

5. Keep equipment out of streams to extent possible.

6. Limit the amount of streambank excavation to the minimum that is necessary to ensure stability of enhancement structures. Place excavated material as far above the high water marks as possible to avoid its reentry to the stream.

7. Whenever possible obtain logs for habitat improvement structures from outside the riparian zone or at least 200 feet from the stream channel to maintain integrity of riparian habitat and streambanks.

8. Inspect all mechanized equipment daily to help ensure toxic materials such as fuel and hydraulic fluid do not enter the stream.

10. Utilize waterbars, barricades and seeding to stabilize bare soil areas.

D. Mining

Objectives: To minimize disturbance to soils, riparian ecosystems, streambanks, and stream channels within constraints of surface mining regulations.

Practices:

1. Require the claimant to obtain all required state and federal operating permits.

2. Locate, design, operate and maintain sediment settling ponds in conformance with State Department of Environmental Quality (DEQ) requirements.

3. Design, locate and construct stream crossings in conformance with Practices described in Sections II.C and II.D.

4. Use existing roads, skid trails and stream crossings whenever possible.

5. Prior to the first wet season, rip, waterbar, seed, mulch, and barricade according to BLM specifications, all roads and trials constructed for exploratory purposes that are unnecessary for the mining operation.

6. Waterbar and barricade all natural surface roads and trails when the operation concludes.

7. Rip, waterbar, seed mulch and barricade all natural surface roads and trails when the operation concludes.

8. Construct a berm or trench between disturbed areas and water courses.

9. Stockpile topsoil for use during reclamation of the site. Construct a berm or trench immediately downslope of the stockpile.

10. Stabilize and contour the area, replace topsoil and mulch, seed and plant the area with tree seedlings in accordance with specifications when no further mining is contemplated.

11. During the period from October 15 to May 15 contour and mulch disturbed areas that will not be mined for at least 30 days.

12. Retain an undisturbed riparian buffer strip between mining operations and water courses to protect integrity of streambanks, provide for water temperature control and for filtration of sediment from surface runoff.

13. Confine operations to bench areas rather than allow encroachment on the stream whenever possible.

14. Locate and maintain sanitation facilities in accordance with State DEQ Regulations.

E. Wetlands

Wetland protection: Maintaining the integrity and functional ability of wetlands by avoidance whenever possible. All wetlands destroyed by construction activities will be ameliorated by creating replacement wetland areas. Protection is accomplished in these areas during timber harvest activities by: a) avoiding disturbance of permanent high water table areas; b) falling and yarding away from wetlands; c) utilizing seasonal restrictions or full suspension over areas when entry is determined to be required; d) avoiding the use of tractors or other ground-basket equipment which may cause disturbance of the wetlands.

Appendix 2-2
Selection of Harvest Scheduling Model and Allowable Sale Quantity Calculation Process

Early in the planning effort, in 1986, BLM began to explore the timber harvest scheduling model options available for BLM's use. A timber harvest scheduling model combines timber production capability, operations inventory, and forest inventory plot data with proposed timber management prescriptions and land use allocations to determine potential annual timber harvest levels and their long term sustainability. By early 1987 we had tentatively identified a model called TRIM-Plus as most relevant to our needs and in the spring of 1987 held public workshops about it for interested parties in some of BLM's western Oregon offices. After considering the comments received that spring and summer, and testing the model on data from the late 1970s, BLM did select the TRIM-Plus Model.

The features of TRIM-Plus most influenced the selection of the model were its ability to:

- make individual nondeclining harvest level calculations on multiple minimum harvest ages.
- handle various land use classes simultaneously.
- be used at district level on enhanced personal computers.
- provide enhanced report generating.
- provide simplified input/output data (ease of use).
- provide relatively inexpensive computer runs.

Although we considered harvest scheduling models of various degrees of complexity, it was our intent to identify a relatively simple and reliable state-of-the-art system. We wanted to be able to interface the selected model with other specific resource analysis models/procedures such as an elk habitat model which will use our automated (mapped) resource data base. The planning process will identify different combinations of land use allocations in terms of acres and the model will compute resulting harvest level impacts in a trackable fashion.

ASQ Calculation Process

Allowable Sale Quantity (ASQ) is an expression of the maximum non-declining level of timber harvest sustainable over time. The ASQ is estimated by TRIM-Plus, a binary search type model that has been designed to operate on a desktop PC. TRIM-Plus functions similarly to the SIMIX model used by the BLM to generate ASQs in the 1970's and 1980's. ASQ volumes from TRIM-Plus are in merchantable cubic feet. Equivalent estimates in board feet are provided to help interpret the information.

Harvest scheduling involves quantifying the existing forest inventory and projecting the inventory into the future along with specific management regimes and harvesting constraints to determine a long term, non-declining harvest level. This harvest level is referred to as the ASQ.

The ASQ is determined through the use of Micro*STORMS (a relational data base), Organon, (a growth and yield model) and TRIM-Plus (a harvest scheduling model). Some assumptions about future management that directly affect the ASQ runs in TRIM-Plus include minimum harvest age, regeneration lag, future stocking levels, anticipated gains for planting genetically improved stock, the amount and frequency of precommercial thinning, commercial thinning and fertilization, and the stand age when these treatments are applied.

When all of the acres, volumes and management assumptions are assembled in the appropriate files in TRIM-Plus, the model makes repetitive ASQ runs to find the optimal sustainable harvest level for a particular management scenario. After the total ASQ run is completed, further analysis of the contribution of each GRU, Resource Area, SYU, or land status type can be made.

Current Acres

GIS Map Acres

Acres for each alternative are derived from digitized GIS map overlays. There is a separate digital map for each topic or theme pertinent to the alternative. These maps can be overlayed or merged to allow analysis and generation of acres for a wide variety of situations.

Micro*STORMS Data Base

The basic storage location for acres and forest related resource information is a large relational data base called Micro*STORMS. The database is separated into three primary files; 1) Forest Operations Inventory (FOI) which includes acreages, timber type, site, treatments, etc., 2) Timber Productivity Classification (TPCC), and 3) 5-Point Continuous Forest Inventory (CFL) plot data.

Within each file, there is a separate record of information for each plot or unit. Each file contains many kinds of data. For example, the FOI file records contain data such as the Basic Resource Unit (BRU) and Existing Stand Condition (ESC) codes, acreage, timber type, site index, accomplished and recommended treatments, timber volumes, stand age, and land use. Information pertinent to the analysis of alternatives from these or other data files has been linked to their respective digitized GIS maps.

Basic Resource Units (BRU). With TRIM-Plus, data is segregated by Sustained Yield Unit (SYU), Resource Area, land status, management status and timber type. These groups of data area called Basic Resource Units. The ASQ and other output data from TRIM-Plus is reported by BRU and for groups of BRUs known as Group Resource units (GRU) as well as for the entire sustained yield unit.

GRU Managment Intensity (MI) Levels. Within each GRU in TRIM-Plus model, there are eight available management regimes called MIs that can be used to simulate various management assumptions or intensity levels. Each requires yields and acres by age class, and information which will direct the shifting of acres from one MI to another during the growth and/or at final harvest for a stand type. Specific configuratin of the MI's varies within each GRU and within each alternative.

Existing Stand Condition (ESC) Codes. ESC codes are incorporated in each BRU. ESC codes help to group, sort and track similar kinds of stands. This sorting is accomplished by giving each Micro*STORMS site file record (FOI Unit) an ESC code which best describes the forest stand or condition of a particular unit.

5-Point Continuous Forest Inventory (CFI)

Tree volumes estimates for present stands were derived from 508 permanent inventory plots distrubuted throughout the District. Both conifers and hardwoods were cruised by certified BLM cruisers to the same standards used in timber sale preparation. Summary plot data is stored in the Micro*Storms data base CFI file. These data include general site and specific stand descriptors such as board foot (BF) and CF volume estimates, growth, basal area, trees per acre, and average dimater at breast height and total tree height.

Yields Estimation

Managed Stands - Yields for managed stands were projected using the Organon growth and yield model. The Organon yield simulator is built upon a database derived from research plots installed in mixed conifer stands of southwestern Oregon. The study area for this model is adjacent to and south of the Roseburg District. The Organon growth and yield model was designed primarily to simulate the growth and yield of Douglas fir and mixed conifer stands of southwestern Oregon. Site index, fertilization, commercial and precommercial thinning, stocking levels, and hardwood competition are some of the input variables that Organon can accommodate in making yield projections. The BLM version of Organon incorporates BLM's own volume regressions and crusing standards.

The Organon model provides an option to use tree list and tree condition data from existing stands as a starting point for simulation. Sources of tree list data include forest inventory plot strata and/or special stand exams to portray average stand conditions. The simulation of yields for representative future plantations requires considerable professional judgment and knowledge of tree growth and stand characteristics unique to the Roseburg district. An adjustment was made in developing yield curves for fertilization. This adjustment reduced yield 15 percent due to application irregularities. This was based on research data that shows that response is not in direct proportion to application rate. (Silviculture Working Group - April 1989, IM-OR-90-272.)

All Organon yields are gross volumes. Reductions for insect and disease losses, and for defect and breakage based on District timber sale data is applied to the

projected yields for future stands. A series of Organon runs were made to determine yields for combinations of operationally feasible and optimal practices.

Gains from the genetic tree improvement program have been calculated by the District Geneticist. To incorporate these gains into TRIM-Plus, the Organon runs were adjusted by raising the site index until volume matches the anticipated gain from planting improved stock.

Unmanaged Stands. In contrast to yields from published stand tables or simulation used with managed stands, yields for unmanaged stands were calculated from existing plots. These empiric yields are preferred over published yield tables whenever there are sufficient plot data on which to build yield curves. Empiric yield curves were generated for unmanaged conifer stands for the average site index of each SYU.

Future Yield Projections

Future yields for managed stands were projected using the Systum-1 young stand model (Ticknor et al, 1989) and the SW-Organon growth and yield model (Hester et al, 1989). Systum-1 was used to generate tree lists representing current and expected future even-aged young plantations resulting from clearcut type harvests. These tree lists were grown in Systum-1 up to age 15, exported to Organon and simulations continued. Organon was used to project older existing plantation conditions under different silvicultural prescriptions. Organon was also used to estimate older stand development and yields for currently unmanaged stands and future managed stands subject to partial cut harvests. These partial cut yield projections are used in alternative C and the Connectivity and OGEA land allocations of alternative P.

Systum-1 is an individual tree, distance-independent growth model suitable for growing trees from a minimum of three years of age up to a size compatible with entry into growth models suitable for older stands such as Organon. It was developed by U.S. Forest Service, Pacific Southwest Experiment Station from sampling plots located in the major forest types of northern California and southern Oregon. Conifer trees can be grown with or without simulated competion from herbaceous, shrub and hardwood competition. A direct output link is supplied from Systum to Organon.

SW-Organon is an individual tree, distance-independent growth and yield model. It was developed by Oregon State University from sampling plots located in the mixed conifer zone of southwestern Oregon. The Organon growth and yield model is designed primarily to simulate the growth and timber yield of Douglas-fir and mixed conifer stands. The model was designed to allow projections of both even-aged and uneven-aged stand conditions under different treatment prescriptions. Prescriptions modelled can include precommercial thinning, commercial thinning, fertilization and different regeneration harvest scenarios alone or in various combinations. Tree lists reflecting a variety of different stand conditions are used as a starting point for simulation. Sources of tree lists for simulation of yields in the different alternatives were the district's Continuous Forest Inventory (CFI) plots and special stand exams. The versions of Organon used for yield simulation incorporate BLM's own volume equations and merchantability standards.

All Organon yield outputs are gross volumes. Net volumes available for harvest were calculated by reducing gross volumes for factors such as stocking irregularity, insects and disease, defect and breakage and retention of overstory trees where applicable. Alternatives C and P incorporate an additional mortality factor of 2.8 percent per decade for larger trees beginning at age 100. This additional mortality is to account for non-suppression related mortality caused by pathogens and wind as the stand ages.

Projections of future yields of young managed stands were done using tree lists that represent the average condition for a grouping of stands which are similar in condition. CFI plots for existing young even-aged managed stands were grouped by existing stand condition (ESC). The stands were projected forward in Organon and yields compared at ages 50 and 100. Ages 50 and 100 were used as the probable range of rotation ages for even-age stands in most of the alternatives. The plot with yields that was closest to the average yield of all plots in an ESC at both age 50 and 100 was used to simulate the the silviculture prescriptions to be applied to that ESC. Tree lists for simulating future even-aged stands resulting from harvest utilized average conditions such as tree heights, diameters and species composition of the current 5 and 10 year old plantations. Tree lists were generated in the Systum-1 young stand model using these average characteristics, grown to age 15 and exported to Organon for further simulation.

Modelling of partial cut and uneven-aged silvicultural prescriptions required a further subdivision of stand groupings for the existing unmanaged stands. Each CFI plot tree list was input into Organon and both tabular and graphical outputs of current plot characteristics were produced. Plots with an ESC of no past management (ESC 40) were catergorized based on like characteristics such as similarity of stand structure, number of large trees, range of volumes, hardwood component etc. Other ESC's with small acreages were

lumped in with ESC 40. Silvicultural prescriptions were developed using a representative (average) plot from each grouping. These stand groupings were used in simulations for alternatives C and P. Alternative P also utilizes the existing managed plantations groupings described previously.

Gains from genetic tree improvement were calculated from progeny test site data. To incorporate gains from genetics, the site index for silvicultural prescriptions including genetically improved seedlings was raised to correlate with expected height gain at age 15. Gains were reduced to account only for the improvement of Douglas-fir in mixed species stands.

Allowable Cut Effect (ACE)

The Roseburg District's commerical timberlands are composed primarily of old-growth (200+ years old) and recently cut over stands which exhibit a relatively low average annual growth. This results from slow or negative growth of the old stands and reflected in that merchantable growth is not measurable in the young stands until they approach 20 years of age. Such a forest is termed "in transition" from an unmanaged to a managed or regulated state.

In the classical sense, the regulated state is achieved when average annual harvest and growth are in equilibrium. At this point, maximum yield on a sustainable basis is reached. To compute an ASQ for a forest in the transition state using this criteria would be extremely conservative and greatly lengthen the time until the regulated state was achieved.

The BLM uses an alternative approach which is to project growth into the future based upon assumptions about management levels and to utilize excess harvest age timber (mainly old-growth) to bridge the time gap until the ultimate growth level is achieved. This process of taking credit now for future growth resulting from intensive management practices has been termed the "allowable cut effect" (ACE). Sensitivity analysis runs identify elements of the ACE.

Appendix 2-3
Silvicultural Systems and Timber Harvest Methods Considered in the Common Alternatives

This appendix describes the the silvicultural systems and the timber harvest methods associated with each considered in the common alternatives.

Silvicultural Systems

Silvicultural systems define the sequence of management practices that take place over the entire life of stands in managed forest landscapes. These systems are designed for the successful and sustainable implementation of land use objectives. They are also designed to be consistent with the current conditions, physical sites, and the plant communities of the lands being managed. Silvicultural systems must be reasonable and implementable as well as economically feasible.

In the development of the RMP, two general silvicultural systems were designed to meet the objectives of the alternatives. These systems are defined as Even-aged and Structural Retention. Even-aged systems are applied in alternatives A, B, D, E, and PA (the preferred alternative). Structural Retention systems are employed in alternatives C and PA.

Each general silvicultural system was designed to move stands from their current condition along a developmental pathway toward a desired or "target" stand condition. For example the general target for alternative A is the development of very regular even-aged stands emphasizing high production of timber yield. In contrast, the general target for alternative C is the development of diverse stands emphasizing the objective of creation or maintenance of biological diversity. Each silvicultural system consists of three phases: stand regeneration, stand management and stand harvesting.

Several formulations of each general system were developed to evaluate different levels of management intensity, different rotation lengths, and different developmental trajectories for each stand.

Design and Selection of Silvicultural Systems

Silvicultural systems are designed at a general level for the planning process and at a more detailed site specific level for individual forest management actions. At both levels the design process follows the same steps.

Silvicultural prescriptions begin by considering land use allocations and management objectives. Current stand conditions and landscape conditions, together with physical site characteristics usually limit the number of ways a stand can be managed.

Selection of a method for reaching a target stand or landscape condition requires consideration of successional pathways and functional relationships within particular plant communities. It also requires a knowledge of the biological potential of the site, processes required to maintain forest health and habitat requirements of plant and animal species. In addition the selected method must assure that the harvested area can be reforested and that the managed ecosystem is sustainable. Reforestation is the most critical part of any silvicultural system.

Successful implementation of the silvicultural system, together with providing for environmental protection and maintenance of long term site productivity is the basis for design of timber sale actions. This includes selection of the logging systems and development of transportation networks.

Silvicultural system design also considers wood products value and quality through features such as rotation lengths, stand density regulation, and tree pruning.

Even-aged Systems

Even-aged systems involve the management of of both existing even-aged stands and the creation of new even-aged stands through harvesting or stand conver-

sion activities. Even-aged systems are employed in alternatives A, B, D, E, and the General Forest Management Area (GFMA) of alternative PA.

Even-aged systems can provide for some level of structural retention, including green tree retention, snags and down woody debris, but at levels below those detailed for structural retention systems. For example, levels of green tree retention range from no trees per acre in alternative A to 6-8 larger trees per acre in alternative PA.

The even-aged systems assumed for Roseburg District most closely match the classical silvicultural systems definitions that describe the clearcut and seed-tree methods (Smith 1962). A major difference in contrast to the classical definitions is that green trees retained under Roseburg District systems are not planned for removal after regeneration is established.

Stand Regeneration

Stands managed under even-aged systems are usually regenerated by planting, often subsequent to a site preparation action such as prescribed burning. For the next decade and subsequent decades the emphasis is on the planting of genetically improved stock whenever it is available. Natural regeneration may also occur from retained green trees in the harvested units and adjacent timber stands.

During the regeneration period of the stand, usually the first 5-10 years after harvest, stand manintenance actions may be necessary to maintain survival and growth of the regeneration. These practices include control of competing vegetation, protection from animal damage, and seedling shading.

Stand Management

Following the regeneration phase, even-aged stands are subjected to treatments designed primarily to produce higher timber yields.

Stand management practices include control of species composition and stand density. Release practices are employed to ensure that tree growth is not slowed by competing vegetation and that commercial trees are not displaced by significant numbers of low value or non-merchantable species. Density control through precommercial thinning ensures that growth is concentrated in selected trees and increases the opportunity for early future commercial thinning.

As stands grow and age, competition between trees for growing space naturally reduces the density of stands through mortality of some trees. Commercial thinning captures this potential mortality by removing trees which would otherwise die and decay prior to final harvest.

Forest fertilization may be employed to temporarily increase stand growth. Timing of fertilizer application is often in conjunction with either precommercial or commercial thinning actions.

Pruning could be employed to increase wood quality through production of clear wood on short rotations.

Stand Harvesting (Regeneration Cuts)

Stand harvesting under even-aged systems may occur at any time above a specified minimum harvest age set to meet land use objectives and economic plus logging practicality. Under this system the entire stand is usually harvested except for a low level of designated green trees and snags retained which varies by alternative. Over time, stands managed under even-aged systems would be harvested near culmination of mean annual increment (CMAI). CMAI varies by site quality and kinds of silvicultural practices employed and the timing of these practices. For even-aged systems on the Roseburg District, CMAI varies between 90-110 years of age.

Structural Retention Systems

These silvicultural systems are designed to retain or recreate forest ecosystems that more closely resemble natural systems in composition, structure, and function. Retained structural components include live trees, snags, and large down woody debris. These may be distributed in various ways in the stand and on the landscape. Hardwoods would be retained or restored in stands at a level consistent with the identified target stand objectives. These systems attempt to maintain natural ecosystem processes through retention and recreation of structure. Structural retention systems attempt to provide for maintenance of site productivity, wildlife habitat, and a high level of biological diversity in a managed landscape.

Structural retention systems are employed in alternatives C and the Connectivity (CONN) and Old Growth Emphasis Areas (OGEA) of alternative PA.

Silvicultural practices used are modifications of those used in even-aged systems, and reflect attempts to redirect ecosystem processes, rather than replace those processes with agricultural style management.

Stands which result from the application of structural retention systems will usually be multiple-canopied and multiple-aged, but not all-aged. The systems assumed for Roseburg District most closely match the classical silvicultural systems definitions that describe the irregular shelterwood and group selection methods (Smith 1962).

Two levels of structural density systems were designed, incorporating a method for restoring structure to stands which are currently even-aged. These levels are designated as low retention and high retention, reflecting the degree of retained green trees following a regeneration harvest.

Low Retention - is a system designed to mimic a moderately heavy large scale natural disturbance event which results in the initiation of a new stand cohort. The objective of this system is aimed at retention of structural components which contribute to long term site productivity and decrease the time before mature/old-growth characteristics are regained after regeneration harvest.

High Retention - under objectives for alternative C this system is designed to accelerate stand development back to later seral stage characteristics more quickly than the low retention system. It attempts to mimic a natural disturbance event of lesser but still large scale severity which results in the initiation of a new cohort of regeneration. Under alternative PA the system is designed to mimic small scale natural disturbances which result in regeneration of a new cohort of trees within the disturbance area. It is expected that this system would introduce additional diversity into the management unit but without significantly changing the overall stand characteristics on a broad scale. Initial canopy levels would be light enough to allow for regeneration of Douglas-fir although growth of the regeneration would be significantly reduced.

Stand Regeneration

Stands managed under the structural retention systems are usually regenerated by planting of Douglas-fir and other species, often subsequent to a site preparation action such as prescribed burning. Genetically improved stock would be used when available. Performance of genetically improved stock and its percent representation under these systems are uncertain so no timber yield increase is assumed from its use.

Natural regeneration can be expected and will be of mixed species dependending on species of retention trees, original hardwood species component and adjacent timber stands composition.

During the regeneration period of the stand, stand maintenance practices similar to those employed under the even-aged systems may be used to maintain survival and growth of the regeneration. These practices include control of competing vegetation and protection from animal damage.

Stand Management

Stands created under this system receive treatments designed to meet structural and functional objectives. Following the regeneration phase, structural retention stands are subjected to treatments designed primarily to maintain structure and promote development of multiple-canopied stands.

Stand management practices include control of species composition and stand density. Density control through precommercial thinning ensures that growth is concentrated in selected trees of diverse species to promote structural development.

Density management is also practiced when the understory reaches merchantable size in multiple-canopied stands and current even-aged stands. In both stand types the objective is to maintain or develop within stand diversity and decrease the time necessary for attainment of late seral stage stand characteristics. Under the high retention system removal of about one quarter of the retention trees is scheduled about 50 years after a regeneration harvest in order to maintain understory growth. Major differences between density management and the commercial thinning practices described under the even-aged system are the distribution of tree sizes removed or retained, species favoured or discriminated against, later ages of intermediate harvest, and allowance for a more irregular spacing pattern i.e. variable spacing, small canopy gap creation.

Forest fertilization may be employed as appropriate in stands which are currently even-aged. Fertilization will not be used when stands are multiple-canopied.

Pruning could be employed to increase wood quality and obtain desired structural characteristics. An example might be pruning for reduction of wildfire hazard such as where density management to low densities results in perpetuation of unacceptable fuel ladders.

Stand Harvesting (Regeneration Cuts)

These systems seek to retain or recreate the characteristics of older forest seral stages, and are managed under longer rotations than the even-aged systems. Harvest of existing stands may occur at any time above the specified minimum harvest age set to meet land use objectives and logging practicality. Over time, stands managed under structural retention systems would be harvested from about 150-300 years of age. Harvest units undergoing regeneration cuts could vary in size from small patch cuts (1/2-5 acres) to larger units determined by site specific objective.

Low Retention - The regeneration harvest will resemble a shelterwood cut with trees scattered irregularly and/or grouped. Individual arrangement with vary by stand type and site specific plus landscape objectives. Approximately 12-16 green conifers per acre usually greater than 20" diameter are retained. Two or three of the larger hardwoods are retained when present. Live conifer basal area retention is approximately 65-80 square feet per acre. Live hardwood basal area retention is assumed to be as high as 10 square feet per acre when hardwoods are available. Conifers are retained proportionally to their occurence in the stand with 20" assumed to be the smallest diameter class usually retained. Site specific conditions may require smaller trees be retained. Retained trees will represent a range of vigour and condition. Existing snags and down woody material are retained.

High Retention - The regeneration harvest will resemble a shelterwood cut (alternative C) with trees scattered irregularly and/or grouped or, group selection cuts of 1/2-5 acres patches. Individual arrangement will vary by stand type and site specific plus landscape objectives. Approximately 20-25 green conifers per acre usually greater than 18" diameter are retained. Two or three of the larger hardwoods per acre are retained when present. Live conifer basal area retention is at least 125 square feet per acre over the management unit. Live hardwood basal area retention is assumed to be as high as 10 square feet per acre when hardwoods are available. Conifers are retained proportionally to their occurence in the stand with 18" assumed to be the smallest diameter class usually retained. Site specific conditions may require smaller trees be retained. Under alternative PA, the harvested areas will resemble group selection patch cuts with 6-10 green conifers per acre retained in the harvested areas. For both alternatives, retained trees will represent a range of vigour and condition. Existing snags and down woody material are retained.

Appendix 2-4
Description of Tree Improvement Program

The study of genetic variation in forest trees expanded rapidly in the 1950's and led to the development of operational tree improvement programs. The BLM began its first attempts at genetic improvement of Douglas-fir to enhance growth characteristics in the mid 1960's. The selection of trees was done in a manner to maintain a high level of genetic diversity by sampling the broad range of the district's seed zones and elevational bands. The first field tests of progeny of Douglas- fir on the district were begun in 1974. There are currently 2223 Douglas-fir, 419 sugar pine, 25 western white pine and 86 ponderosa pine parent trees selected. The district has 52 Douglas-fir progeny tests established with 5650 parent trees under test. The Roseburg District is currently producing about 30 percent of its Douglas-fir seed from improved sources. In 12 to 15 years, most of Roseburg's Douglas-fir seed will come from genetically improved seed orchards.

In addition to seed produced from seed orchards, collections of seed from natural stands of trees for reforestation purposes are done across the range of seed zones. Whether the seeds are from genetically improved trees or not, seedlings grown from the seed are planted back to match the area where they were collected. Large viable seed banks which contain the full range of seed zones and subzones are highly desirable. Catastrophic events such as the 1987 fires can occur at any time. The district goal is to be prepared to treat scheduled harvest units as well as catastrophes with prompt reforestation from seed with genetic composition that is locally adapted. Seed in storage can thus be considered a genetic and regeneration insurance policy.

Seed zones and Seed Transfer Policy

Seed zones are geographic areas that have been delineated based on climate and geological similarities. Generally seed can move within a zone at the same elevation without loss of genetic adaption. Most district seed zones are represented by several sub-zones based on local experience and are further subdivided by 500 foot elevational bands. This conservative "local is best" seed collection and transfer philosophy reflects the considerable on-site experience of the district's silviculturists, geneticist and tree improvement foresters. It is supported by early work of Hermann and Lavender (1968) and by more recent research by Campbell (1986) on Douglas-fir and by Campbell and Sugano (1987) on sugar pine. The complex environmental gradients associated with the mountainous terrain of southwest Oregon and the possibility of a "template-like" fit of genetically controlled adaptive traits (Silen, Personal Communication, 1988) may make seed zone wide transfers unacceptably risky, even within 500 ft. elevational bands. Indeed, Campbell (1986) found E-W gradients were steeper than elevational changes. It is noteworthy that the Roseburg Tree Improvement Cooperative Program addresses such concerns by (1) testing a very large number of parent trees (5650), (2) divided among 15 separate breeding units, (3) tested across an unusually large number of progeny sites (176), (4) representing ten different cooperators, and with (5) parents allocated to "sets" of 30 trees each, defined by geographic proximity, for testing.

Past, wider movement of seed provide ample illustrations to emphasize this point. For example, unusually cold weather in the winter of 1991 killed several *Eucalyptus spp.* trees on the Roseburg District Office grounds. Another exotic, KMX (Knobcone-x-Monterey pine cross), also suffered considerable mortality and widespread damage in local forestry plantations.

A less graphic, but widely recognized example of improper seed transfer is evident in practically all ponderosa pine plantations of the 1950-1960's era on the Roseburg District and surrounding USFS lands. Apparently, most seedlots originated from the beautiful, natural ponderosa pine stands east of the Cascade Mountains. In contrast to their vigor in their own locale, these "off-site" provenances suffer considerable mortality and general debilitating foliar damage from a needle cast disease, *Lophodermella cerina,* when planted west of the Cascades. Most surviving individuals are of such poor form and vigor that they will never make crop trees; they are gradually being overtopped by other "native" trees, either planted or naturally seeded.

Unfortunately, the risk to other "off-site" plantings may yet to be recognized. Marginally adapted seed sources may survive and grow reasonably well until the unusual and unpredictable "one in a 100-year" environmental phenomenon, such as the 1955 November freeze or the 1962 Columbus Day storm, occur. Thus, it seems only prudent to limit seed transfer as narrowly as practically possible. Conservative transfer of seed is not without attendant costs; smaller seedlots require

added collection, extraction and storage costs as well as increased nursery charges. In addition, numerous, small seedlots must total to a greater combined weight than one generalized lot because less than perfect demand predictions and nursery inflation factors necessitate an "insurance overage" of about 25 percent for each seedlot.

Biological concerns associated with small seedlots may be of more relevance than monetary costs. For example, cones from at least 10 and typically 20 or more trees should be included in each seedlot for genetically heterogeneous species such as Douglas-fir and ponderosa pine, although less variable species such as western redcedar should require less entries. Small, "sub-seed zones" also increase the likelihood of voids in cone collections, especially in spotty crop-years like 1991.

One side benefit to small seed sub-zones should be biodiversity considerations. Small, localized seedlots of Douglas-fir *and* minor species should allow regeneration foresters, within limits, to approximate the species composition and genetic diversity present in the previous stand. Furthermore, carefully controlled and orchestrated pollination within orchard units and customizing of orchard seed mixes could even add useful genetic combinations not available in individual, natural stands.

Seed Inventory & Projected Needs

Table 1 summarizes seed inventories by post 1980 and total supply categories, and by seed zone and elevation. It also shows projected 10-year seed needs, based upon our average use during the last 10-year period.

For the district as a whole, improved Douglas-fir seed makes up 13.5 percent of the seed collected in the last 10-years, but is estimated to account for about 30 percent of the Douglas-fir seed production in 1992 (335 out of 1135 lbs). However, unless parent trees are more intensively managed for seed production, this proportion may remain static although demand for improved seed should reduce its inventory more quickly.

Reforestation with species other than Douglas-fir is expected to comprise a larger proportion of seedlings planted than in the past. Douglas-fir accounts for 88 percent of Roseburg's seed currently on hand, whereas it amounts to only 76 percent of expected 10-year needs.

Seed Orchards

The Roseburg District uses carefully designed and managed seed orchards to produce genetically improved seed for reforestation. A few BLM orchard units were established in the early 1970's and are starting to produce now. The majority of Douglas-fir orchard units are currently being established and are at least 10-years away from significant production. Once seed orchards gradually increase production, the proportion of improved to total seed in inventory will increase. The use of open-pollinated seed from parent trees in the field should then decline to zero as seed orchards reach full production.

The BLM also reciprocates in seed exchange with the US Forest Service and recently received our first small lots of seed orchard produced western white pine.

Seed production plantations (much less intensively selected parents and managed units) are planned for more marginal ground in the orchards for minor species, including ponderosa pine, Jeffrey pine, western white pine, grand fir, silver fir, incense cedar, Port Orford cedar, western redcedar, western hemlock, and western yew. A major justification for these orchards is more frequent, reliable production of seed under a more uniform environment. Seed collection costs should also drop appreciably.

Natural Stand Collections

Until orchards approach full production, cone collections from natural stands must assist parent tree production for reforestation. Natural stands are defined as having regenerated from adjacent surviving trees following a natural catastrophe such as wildfire or following a timber harvest where trees on the site were reserved to seed the site. In each case no artificial regeneration by humans has occurred. Special care must be exercised to make certain that cone bearing trees are truly native. Stands of Douglas-fir and ponderosa pine in the 30 to 40-year age classes are particularly suspect. Unfortunately, seed source was not carefully documented, if known, in many of these old harvest units. Careful review of old reforestation record cards is mandatory. If there is any doubt as to the origin of the stand, it should be rejected for future cone collections. Isoenzyme analyses and other chemical finger-printing techniques such as terpene composition comparisons can sometimes be used to verify if suspicious seedlots actually came from natural stands listed in the records.

Appendix 2-4, Table 1. Seed Storage Summary, 10-Year Seed Needs as of 1991

Species	Resource Area	Elevation Seed Zone	Storage (lbs) (1000's ft)	Storage (lbs) 1980 & Later	10-Year Total	Need (lbs.)
Douglas-fir	N. Umpqua	491	1.0	14.3	29.4	5
Douglas-fir	N. Umpqua	491	1.5	122.7	167.3	100
Douglas-fir	N. Umpqua	491	2.0	91.7	114.4	120
Douglas-fir	N. Umpqua	491	2.5	54.2	127.1	120
Douglas-fir	N. Umpqua	491	3.0	306.2	333.6	120
Douglas-fir	N. Umpqua	491	3.5	83.9	205.2	100
Douglas-fir	N. Umpqua	491	4.0	8.7	8.7	35
Douglas-fir	N. Umpqua	491	4.5	3.3	3.3	20
	Genetically Improved			**70.4**	**70.4**	
		Subtotal		**755.4**	**1,059.4**	**620**
Douglas-fir	S. Umpqua	270	1.5	9.2	13.4	10
Douglas-fir	S. Umpqua	270	2.0	30.0	51.5	20
Douglas-fir	S. Umpqua	270	2.5	0	66.6	20
Douglas-fir	S. Umpqua	270	3.0	17.6	29.9	10
Douglas-fir	S. Umpqua	492	1.5	10.3	10.3	40
Douglas-fir	S. Umpqua	492	2.0	0	213.0	175
Douglas-fir	S. Umpqua	492	2.5	0	24.0	125
Douglas-fir	S. Umpqua	492	3.0	0	95.5	75
Douglas-fir	S. Umpqua	492	3.5	0	160.6	25
Douglas-fir	S. Umpqua	492	4.0	0	13.7	
	Genetically Improved			**38.9**	**38.9**	
		Subtotal		**106.0**	**717.5**	**500**
Douglas-fir	Dillard	072	1.0			20
Douglas-fir	Dillard	072	1.5			27
Douglas-fir	Dillard	072	2.0	42.8	64.7	60
Douglas-fir	Dillard	072	2.5			47
Douglas-fir	Dillard	072	3.0		2.5	20
Douglas-fir	Dillard	270	1.5	75.6	84.4	56
Douglas-fir	Dillard	270	2.0	120.3	133.1	106
Douglas-fir	Dillard	270	2.5	113.7	176.2	112
Douglas-fir	Dillard	270	3.0		.8	26
Douglas-fir	Dillard	270	3.5		21.9	32
	Genetically Improved			**58.7**	**58.7**	
		Subtotal		**411.1**	**542.2**	**506**

Appendix 2-4, Table 1. Seed Storage Summary, 10-Year Seed Needs as of 1991 (cont.)

Species	Resource Area	Elevation Seed Zone	Storage (lbs) (1000's ft)	Storage (lbs) 1980 & Later	10-Year Total	Need (lbs.)
Douglas-fir	Drain	252	1.0	293.5	293.5	45
Douglas-fir	Drain	252	1.5	127.0	127.0	115
Douglas-fir	Drain	252	2.0	15.2	15.2	45
Douglas-fir	Drain	270	1.0	13.0	89.2	40
Douglas-fir	Drain	270	1.5	62.9	161.1	75
Douglas-fir	Drain	270	2.0	73.1	81.7	40
Douglas-fir	Drain	270	2.5	12.5	12.5	12
Douglas-fir	Drain	481	1.0	19.4	19.4	11
Douglas-fir	Drain	481	1.5	28.5	28.5	13
Douglas-fir	Drain	481	2.0	39.7	39.7	11
Douglas-fir	Drain	481	2.5	4.6	4.6	611.
	Genetically Improved			**110.9**	**110.9**	
		Subtotal		**800.3**	**983.3**	**413**
Douglas-fir	**District Totals**			**2072.8**	**3302.4**	**2039**
Grand fir	N. Umpqua	491	1.5	18.1	20.9	10
Grand fir	N. Umpqua	491	2.0	11.3	21.2	10
Grand fir	N. Umpqua	491	2.5	10.6	10.6	10
Grand fir	S. Umpqua	492	2.0	1.2	1.2	5
Grand fir	S. Umpqua	492	2.5	1.9	1.9	5
Grand fir	S. Umpqua	492	3.5		3.9	
Grand fir	Dillard	072	1.5		56.2	15
Grand fir	Dillard	270	2.0		7.9	30
Grand fir	Drain	270				15
Grand fir	**District totals**			**43.1**	**123.8**	**100**
Pacific Silver Fir	N. Umpqua	491	4.5			15
Pacific Silver Fir	**District Totals**					**15**

Appendix 2-4, Table 1. Seed Storage Summary, 10-Year Seed Needs as of 1991 (cont.)

Species	Resource Area	Elevation Seed Zone	Storage (lbs) (1000's ft)	Storage (lbs) 1980 & Later	10-Year Total	Need (lbs.)
Ponderosa Pine	N. Umpqua	491	1.5	2.0	2.0	20
Ponderosa Pine	N. Umpqua	491	2.0	4.9	4.9	20
Ponderosa Pine	S. Umpqua	492	1.5	3.1	3.1	10
Ponderosa Pine	S. Umpqua	492	2.0	8.2	8.2	30
Ponderosa Pine	Dillard	072	1.5			10
Ponderosa Pine	Dillard	072	2.0			20
Ponderosa Pine	Dillard	270	1.5			10
Ponderosa Pine	Dillard	270	2.0			65
Ponderosa Pine	Dillard	270	2.5	17.5	17.5	35
Ponderosa Pine	**District Totals**			**35.7**	**35.7**	**220**
Jeffrey Pine	S. Umpqua	270	2.5	6.0	6.0	10
Jeffrey Pine	S. Umpqua	492	3.0	.2	.2	10
Jeffrey Pine	Dillard	270	2.0			
Jeffrey Pine	**District Totals**			**6.2**	**6.2**	
Sugar Pine	N. Umpqua	491	1.5	3	3	20
Sugar Pine	N. Umpqua	491	2.0	50	50	20
Sugar Pine	N. Umpqua	491	2.5	40	40	15
Sugar Pine	N. Umpqua	491	3.0	40	40	5
Sugar Pine	S. Umpuqa	270	2.0-3.0	1.8	1.8	5
Sugar Pine	S. Umpqua	492	1.5-3.5	88.4	88.4	40
Sugar Pine	Dillard	072	1.5	18.6	18.6	20
Sugar Pine	Dillard	072	2.0	.3	.3	20
Sugar Pine	Dillard	270	1.5	6.3	6.3	20
Sugar Pine	Dillard	270	2.0			20
SugarPine	Dillard	270	2.5	13.6	13.6	20
Sugar Pine	**District Totals**			**262**	**262**	**205**
Western White Pine	N. Umpqua	491	4.0			
Western White Pine	S. Umpqua	492	4.0	1.5	1.5	5
Western White Pine	**District Totals**			**1.5**	**1.5**	**5**

Appendix 2-4, Table 1. Seed Storage Summary, 10-Year Seed Needs as of 1991 (cont.)

Species	Resource Area	Elevation Seed Zone	Storage (lbs) (1000's ft)	Storage (lbs) 1980 & Later	10-Year Total	Need (lbs.)
Incense Cedar	N. Umpqua	491	1.5	5.4	7.9	10
Incense Cedar	N. Umpqua	491	2.0			10
Incense Cedar	N. Umpqua	491	2.5		.4	5
Incense Cedar	N. Umpqua	491	3.0			5
Incense Cedar	S. Umpqua	492	2.5	14.0	14.0	5
Incense Cedar	S. Umpqua	492	3.0	.5	.5	2
Incense Cedar	Dillard	270	2.0			20
Incense Cedar	Drain		1.5			10
Incense Cedar	**District Totals**			**19.9**	**22.8**	**67**
Western Redcedar	N. Umpqua	491	1.5		1.5	5
Western Redcedar	N. Umpqua	491	2.0	.8	3.3	6
Western Redcedar	N. Umpqua	491	2.5		.9	4
Western Redcedar	N. Umpqua	491	3.0	1.4	1.4	3
Western Redcedar	S. Umpqua	492	2.0	3.1	3.1	
Western Redcedar	Drain	270	1.5	1.9	1.9	.5
Western Redcedar	**District Totals**			**7.2**	**11.1**	**18.5**
Port Orford Cedar	Dillard	072				
Port Orford Cedar	Dillard	270				
Port Orford Cedar	**District Total**					
Western Hemlock	N. Umpqua	491	2.0	.2	.2	
Western Hemlock	Dillard	072				
Western Hemlock	Drain					.75
Overall District Totals				**2448.6**	**3759.5**	**2670.3**

Appendix 2-5
Land Ownership Adjustment Criteria

In accordance with FLPMA and other laws, Executive Orders, and Departmental and Bureau policy, the following criteria will be used to evaluate opportunities for disposal or acquisition. This list is not considered all inclusive, but represents the major factors to be evaluated. They include:

- Threatened or Endangered or sensitive plant and animal species habitat
- riparian areas and wetlands
- fish habitat
- nesting/breeding habitat for game and non-game animals
- key big game seasonal habitat
- developed recreation sites and recreation use areas
- high quality scenery
- energy and mineral potential
- land adjacent to rivers eligible for designation under the National Wild and Scenic Rivers Act
- significant cultural resources and sites eligible for inclusion on the National Register of Historic Places
- designated wilderness areas and areas being studied for possible wilderness designation
- accessibility of the land for public recreation and other uses
- amount of public investments in facilities or improvements and the potential for recovering those investments
- difficulty or cost of administration (manageability)
- suitability of the land for management by another Federal agency
- significance of the decision in stabilizing business, social and economic conditions, and/or lifestyles
- whether private sites exist for the proposed use
- encumbrances, including but not limited to, withdrawals or existing leases or permits
- consistency with cooperative agreements and plans or policies of other agencies
- suitability (need for change in land ownership or use) for purposes including but not limited to community expansion or economic development, such as industrial, residential, or agricultural (other than grazing) development

Appendix 2-6
Land Tenure
Zone 3 Lands

The following lands meet the criteria for Zone 3 lands as described in Chapter 2. They are isolated and would be difficult and uneconomical to manage. These lands would be available for disposal through exchange or sale.

Legal Description	Acreage and Land Status O&C	P.D.	CBWR
1. T. 30 S., R. 2 W., W.M.			
Sec. 32, Lot 3;		42	
Sec. 34, SE¼SW¼.		40	
2. T. 31 S., R. 2 W., W.M.			
Sec. 4, Lots 1 and 8.		84	
3. T. 24 S., R. 3 W., W.M.			
Sec. 9, W½W¼;	160		
Sec. 15, E½NE¼, W½SE¼, SE¼SE¼;	200		
Sec. 17, Lots 1,2,3, and 4;	154		
Sec. 19, Lots 5 to 12, inclusive;	217		
Sec. 21, NW¼SW¼	40		
Sec. 22, SW¼NE¼, NW¼SW¼;		80	
Sec. 23, NW¼NW¼;	40		
Sec. 31, Lot 1, N½NE¼, SW¼NE¼, E½NW¼, SE¼SE¼.	281		
4. T. 25 S., R. 3 W., W.M.			
Sec. 3, Lots 5,6,7,and 8;	98		
Sec. 4, Lot 5;		23	
Sec. 5, Lots 5 and 6;	52		
Sec. 9, Lots 1 to 5, inclusive.	223		
5. T. 27 S., R. 3 W., W.M.			
Sec. 34, SE¼SW¼.		40	
6. T. 30 S., R. 3 W., W.M.			
Sec. 5, Lots 1 and 2.	19		
7. T. 21 S., R. 4 W., W.M.			
Sec. 19, NW¼SE¼;	40		
Sec. 31, SW¼SW¼, S½SE¼;	122		
Sec. 33, S½SW¼.	80		
8. T. 22 S., R. 4 W., W.M.			
Sec. 7, NE¼, NW¼NW¼, NE¼SE¼.	250		
9. T. 23 S., R. 4 W., W.M.			
Sec. 7, Lot 4, NE¼NE¼, SE¼SW¼, W½SE¼, SE¼SE¼;	240		
Sec. 17, All;	640		
Sec. 19, Lots 2,3,4, NE¼,SE¼NW¼,E½SW¼;	407		
Sec. 20, SW¼NE¼, NW¼SE¼;		80	
Sec. 29, N½NW¼, SE¼NW¼, NE¼SW¼, SW¼SW¼.	200		

Legal Description	O&C	P.D.	CBWR
	Acreage and Land Status		
10. T. 24 S., R. 4 W., W.M.			
Sec. 5, Lots 3 and 4, W½SE¼,	154		
Sec. 25, N½, NW¼SW¼, SE¼;	520		
Sec. 29, NE¼SE¼*;	40		
Sec. 33, SE¼*;	160		
Sec. 35, W½NE¼, E½NW¼, SW¼NW¼, N½SW¼*.	280		
11. T. 25 S., R. 4 W., W.M.			
Sec. 3, NE¼NW¼, NW¼SE¼*;	82		
Sec. 16, NE¼NW¼;		40	
Sec. 17, Lot 5.	17		
12. T. 26 S., R. 4 W., W.M.			
Sec. 10, Lot 1*;		7	
Sec. 17, Lots 9 and 10*.	12		
13. T. 27 S., R. 4 W., W.M.			
Sec. 7, Lot 2*;	4		
Sec. 33, NW¼SW¼.		40	
14. T. 28 S., R. 4 W., W.M.			
Sec. 29, SE¼NE¼.	40		
15. T. 30 S., R. 4 W., W.M.			
Sec. 1, Lot 9.	4		
16. T. 21 S., R. 5 W., W.M.			
Sec. 13, NE¼SW¼, W½SE¼;	120		
Sec. 21, NE¼NW¼;	40		
Sec. 25, S½NE¼, E½NW¼, NE¼SE¼;	200		
Sec. 27, E½NE¼, NE¼SW¼;	120		
Sec.29, NE¼SW¼;	40		
Sec.33, W½NW¼.	80		

Legal Description	O&C	P.D.	CBWR
	Acreage and Land Status		
17. T. 22 S., R. 5 W., W.M.			
Sec. 1, Lots 1, 2, 3, and 4, S½N½, S½;	634		
Sec. 3, Lots 1, 2, SW¼NE¼, S½NW¼;	197		
Sec. 5, NW¼NE¼, N½NW¼, SW¼NW¼, NW¼SW¼,	206		
Sec. 11, NE¼, SWNW¼, W½SW;	280		
Sec. 15, N½NE¼, SW¼NE¼;	120		
Sec. 19, SE¼NE¼;	40		
Sec. 23, NE¼SE¼, S½SE¼;	120		
Sec. 25, SW¼NE¼, S½NW¼, SW¼, W½SE¼;	360		
Sec. 33, W½NE¼, NW¼, NE¼SW¼;	280		
Sec. 35, Lot 1, E½NE¼, N½NW¼.	180		
18. T. 23 S., R. 5 W., W.M.			
Sec. 5, NW¼, N½SW¼, SE¼SW¼;	276		
Sec. 7, NW¼NE¼, SE¼SE¼;	80		
Sec. 13, E½NE¼, SE¼;	240		
Sec. 17, S½SW¼;	80		
Sec. 21, NW¼NW¼.	40		
19. T. 24 S., R. 5 W., W.M.			
Sec. 29, Lot 5.	28		
20. T. 25 S., R. 5 W., W.M.			
Sec. 9, NE¼SW¼, S½SW¼, N½SE¼, SW¼SE¼;	240		
Sec. 27, N½NW¼;	80		
Sec. 29, S½NE¼.	80		
21. T. 28 S., R. 5 W., W.M.			
Sec. 23, SW¼NW¼;	40		
Sec. 28, NW¼NW¼;		40	
Sec. 29, E½NE¼;	80		
Sec. 31, NE¼SE¼.	40		

	Acreage and Land Status		
Legal Description	**O&C**	**P.D.**	**CBWR**
22. T. 29 S., R. 5 W., W.M.			
Sec. 29, NE¼NE¼.	40		
23. T. 30 S., R. 5 W., W.M.			
Sec. 9, Lots 3 and 4;	77		
Sec. 13, Lot 1;	21		
Sec. 17, NE¼NE¼, N½NW¼, SW¼NW¼;	160		
Sec. 19, Lot 1;	38		
Sec. 29, SE¼SW¼, S½SE¼.	120		
24. T. 31 S., R. 5 W., W.M.			
Sec. 4, Lot 6.	33		
25. T. 22 S., R. 6 W., W.M.			
Sec. 15, SE¼SW¼;	40		
Sec. 23, W½NW¼, SW¼, S½SE¼;	320		
Sec. 35, S½S½.	160		
26. T. 23 S., R. 6 W., W.M.			
Sec. 1, Lots 5, 6, and 7.	134		
27. T. 24 S., R. 6 W., W.M.			
Sec. 11, N½NW¼, S½SE¼;	160		
Sec. 13, N½NE¼, NE¼NW¼;	120		
Sec. 15, E½NW¼;	80		
Sec. 27, W½, SW¼SE¼.	360		
28. T. 25 S., R. 6 W., W.M.			
Sec. 3, NW¼NE¼, NE¼SW¼, NE¼SE¼;	122		
Sec. 7, Lots 1, 2, 3, and 4, E½NW¼;	244		
Sec. 33, SE¼SE¼.	40		
29. T. 26 S., R. 6 W., W.M.			
Sec. 3, SE¼NE¼, NE¼SE¼;	80		
Sec. 17, Lot 2, SE¼NW¼, SE¼SW¼, SW¼SE¼.	126		

	Acreage and Land Status		
Legal Description	**O&C**	**P.D.**	**CBWR**
30. T. 29 S., R. 6 W., W.M.			
Sec. 17, Lots 9, 10, and 11, SE¼SE¼;	102		
Sec. 19, NW¼NE¼, N½NW¼, SW¼SE¼.	164		
31. T. 30 S., R. 6 W., W.M.			
Sec. 18, Lots 1 and 2;		39	
Sec. 20, Lots 1,2, and 3;		58	
Sec. 21, NW¼NE¼, NE¼NW¼, SE¼;	240		
Sec. 25, SE¼SE¼;	40		
Sec. 29, N½NW¼.	80		
32. T. 28 S., R. 7 W., W.M.			
Sec. 11, SW¼SE¼;			40
Sec. 14, Lot 1, N½NE¼;		99	
Sec. 15, Lots 7 to 13, inclusive;			197
Sec. 21, N½, N½S½, SW¼SW¼;			520
Sec. 22, SE¼NE¼, S½NW¼;		120	
Sec. 27, Lots 3 and 4.			85
33. T. 29 S., R. 7 W., W.M.			
Sec. 5, NW¼SW¼.	40		
Sub Totals	**12,238**	**832**	**842**
Total		**13,832**	

*Columbian White Tail Deer habitat which would only be disposed after CWTD acquisition proposal completed.

Appendix 2-7 Proposed Restrictions on Mineral and Energy Exploration and Development Activity

Introduction

This appendix discusses the leasing stipulations as they would be applied to BLM managed lands in the planning area under each alternative. Operating standards pertinent to the locatable and salable minerals program are also described. Mineral exploration and development on Federal lands must also comply with laws and regulations administered by several agencies of the State of Oregon; however, these requirements are not discussed in this document.

Leasable Mineral Resources

Oil and Gas Leasing

The Mineral Leasing Act of 1920 (as amended) provides that all publicly owned oil and gas resources be open to leasing, unless a specific land order has been issued to close the area. Through the land use planning process, the availability of these resources for leasing is analyzed, taking into consideration development potential and surface resources. Constraints on oil and gas operations are identified and placed in the leases as notices and stipulations. Oil and gas leases are then issued from the BLM Oregon State Office in Portland. Specific proposed notices and stipulations are listed by alternative later in this appendix.

The issuance of a lease conveys to the lessee an authorization to actively explore and/or develop the lease, in accordance with the attached stipulations and the standard terms outlined in the Federal Onshore Oil and Gas Leasing Reform Act (FOOGLRA). Restrictions on oil and gas activities in the planning area will take the form of timing limitations, controlled surface use, or no surface occupancy stipulations used at the discretion of the Authorized Officer to protect identified surface resources of special concern.

Stipulations will be attached to each lease before it is offered for bid, by the field office which reviews the lease tract. The review will be conducted by consulting the direction given in this Resource Management Plan. In addition, all lands administered by BLM within the planning area will be subject to the lease notices as shown on the following pages. All Federal lessees or operators are required to follow procedures set forth by: Onshore Oil and Gas Orders, Notices to Lessee (NTL), The Federal Oil and Gas Royalty Management Act (as amended), The Federal Onshore Oil and Gas Leasing Reform Act, and Title 43 Code of Federal Regulations, Part 3100.

Oil and Gas Operations

Geophysical Exploration

Geophysical operations may be conducted regardless of whether the land is leased or not. Notices to conduct geophysical operations on BLM surface are received by the Resource Area. Administration and surface protection are accomplished through close cooperation of the operator and the BLM. Seasonal restrictions may be imposed to reduce fire hazards, conflicts with wildlife, watershed damage, etc. An operator is required to file a "Notice of Intent to Conduct Oil and Gas Exploration Operations" for all geophysical activities on public land administered by BLM. The notice should adequately show the location and access routes, anticipated surface damages, and time frame. The operator is required to comply with written instructions and orders given by the AuthorizedOfficer, and must be bonded. Signing of the Notice of Intent by the operator signifies agreement to comply with the terms and conditions of the notice, regulations, and other requirements prescribed by the Authorized Officer. A pre-work conference and/or site inspection may be required. Periodic checks during and upon completion of the operations will be conducted to ensure compliance with the terms of Notice of Intent, including reclamation.

Drilling Permit Process

The federal lessee or operating company selects a drill site based on spacing requirements, subsurface and surface geology, geophysics, topography, and economic considerations. Well spacing is determined by the Authorized Officer after considering topography, reservoir characteristics, protection of correlative rights, potential for well interference, interference with multiple use of lands, and protection of the surface and subsurface environments. Close coordination with the State would take place. Written field spacing orders are issued for each field. Exceptions to spacing requirements involving Federal lands may be granted after joint State and BLM review.

Notice of Staking

Once the company makes the decision to drill, it must decide whether to submit a Notice of Staking (NOS) or apply directly for a permit to drill. The NOS is an outline of what the company intends to do, including a location map and sketched site plan. The NOS is used to review any conflicts with known critical resource values and to identify the need for associated rights-of-way and special use permits. The BLM utilizes information contained in the NOS and obtained from the on-site inspection to develop conditions of approval to be incorporated into the application for permit to drill. Upon receipt of the NOS, the BLM posts the document and pertinent information about the proposed well in the District Office for a minimum of 30 days prior to approval, for review and comment by the public.

Application for Permit to Drill (APD)

The operator may or may not choose to submit a NOS; in either case, an Application for Permit to Drill (APD) must be submitted prior to drilling. An APD consists of two main parts: a 12-point surface plan that describes any surface disturbances and is reviewed by resource specialists for adequacy with regard to lease stipulations designed to mitigate impacts to identified resource conflicts with the specific proposal, and an 8-point subsurface plan that details the drilling program and is reviewed by the staff petroleum engineer and geologist. This plan includes provisions for casing, cementing, well control, and other safety requirements. For the APD option, the on-site inspection is used to assess possible impacts and develop provisions to minimize these impacts. If the NOS option is not utilized, the 30 day posting period begins with the filing of the APD. Private surface owner input is actively solicited during the APD stage.

Geothermal Leasing

The Geothermal Steam Act of 1970 (as amended) provides for the issuance of leases for the development and utilization of geothermal steam and associated geothermal resources. Geothermal leasing and operational regulations are contained in Title 43 Code of Federal Regulations, Part 3200. Through the land use planning process the availability of the geothermal resources for leasing is analyzed, taking into consideration development potential and surface and subsurface resources. Constraints on geothermal operations are identified and placed in the leases as stipulations. Geothermal leases are then issued by the BLM Oregon State Office in Portland.

Geothermal resources within a known geothermal resource area (KGRA) are offered by competitive sale. Outside of KGRAs, leases can be issued non-competitively (over- the-counter). Prior to a competitive lease sale, or the issuance of a noncompetitive lease, each tract will be reviewed, and appropriate lease stipulations will be included. The review will be conducted by consulting the direction given in this resource management plan. The issuance of a lease conveys to the lessee authorization to actively explore and/or develop the lease in accordance with regulations and lease terms and attached stipulations. Subsequent lease operations must be conducted in accordance with the regulations, Geothermal Resources Operational Orders, and any Conditions of Approval developed as a result of site-specific NEPA analysis. In the planning area, restrictions in some areas will include timing limitations, controlled surface use, or no surface occupancy stipulations used at the discretion of the Authorized Officer to protect identified surface resources of special concern.

In addition to restrictions related to the protection of surface resources, the various stipulations and conditions could contain requirements related to protection of subsurface resources. These may involve drainage protection of geothermal zones, protection of aquifers from contamination, or assumption of responsibility for any unplugged wells on the lease.

Development of geothermal resources can be done only on approved leases. Orderly development of a geothermal resource, from exploration to production, involves several major phases that must be approved separately. Each phase must undergo the appropriate level of NEPA compliance before it is approved and subsequent authorization(s) is (are) issued.

Leasing Notice and Stipulation Summary

On the following pages, the mineral leasing notices and stipulations are shown by planning alternative. The tracts of land to which these apply will, in many cases, differ by alternative. Those notices and stipulations shown as common for all alternatives are considered to be the minimum necessary in order to issue leases in the operating area. Under all alternatives, the standard leasing stipulations (Form 3100-11) alone would be utilized on most lands. The powersite stipulation (Form 3730-1) would be utilized on lands within powersite reservations.

Stipulations also include waiver, exception, and modification criteria defined below. If the Authorized Officer determines that a stipulation involves an issue of major concern, waivers, exceptions, or modifications of the stipulation will be subject to at least a 30-day advance public review (43 CFR 3101.1-4). Waiver, exception, and modification are defined as follows:

> Waiver - The lifting of a stipulation from a lease that constitutes a permanent revocation of the stipulation from that time forward. The stipulation no longer applies anywhere within the leasehold.
>
> Exception - This is a one time lifting of the stipulation to allow an activity for a specific proposal. This is a case-by-case exemption. The stipulation continues to apply to all other sites within the leasehold to which the restrictive criteria apply. It has no permanent effect on the lease stipulation.
>
> Modification - This is a change to a stipulation that either temporarily suspends the stipulation requirement or permanently lifts the application of the stipulation on a given portion of the lease. Depending on the specific modification, the stipulation may or may not apply to all other sites within the leasehold to which the restrictive criteria apply.

Throughout the alternatives, the “no surface occupancy” stipulation is used rather than not leasing, because leasable minerals, if present, can be produced from most, if not all, of each of the parcels that are subject to this stipulation without impacting the value(s) needing protection.

Whenever a special stipulation, such as No Surface Occupancy (NSO), Timing, or Controlled Surface Use (CSU) is used, the need for the special stipulation is described in the “Objective” that follows the stipulation. By imposing these special stipulations, it has been concluded that less restrictive stipulations would not be adequate to meet the stated objective.

Leasing Notices

The following Notices are to be included in each lease for all lands administered by BLM within the planning area where the pertinent resource potential exists. Lease notices are attached to leases in the same manner as stipulations; however, there is an important distinction between lease notices and stipulations. Lease notices do not involve new restrictions or requirements. Any requirements contained in a lease notice must be fully supported in either laws, regulations, policy, onshore oil and gas orders, or geothermal resources operational orders.

Leasing Notices Common To All Alternatives

Notice

Wildlife - Northern Spotted Owl Nest and Roost Sites and Associated Habitat

The leased lands are in an area suitable for the habitat of the Northern Spotted Owl, *(Strix occidentalis caurina),* an animal species that is officially listed (Federal) as a Threatened species.

All viable habitat will be identified for the lessee/ operator by the Authorized Officer of the BLM during the preliminary environmental review of the proposed surface use plan. If the field examination indicates that the proposed activity may affect the species, then consultation will be conducted with the U.S. Fish & Wildlife Service pursuant to Sec. 7 of the Endangered Species Act of 1973, as amended. The consultation will determine whether or not the proposed activity would jeopardize the continued existence of the species, and, if so, the extent, if any, the proposed activity will be allowed.

Authority: The Endangered Species Act of 1973.

Notice

Wildlife - American Peregrine Falcon Nest Sites and Nesting Habitat

The leased lands are in an area suitable for the habitat of the American Peregrine Falcon (Falco peregrinus anatum), an animal species that is officially listed as an Endangered species.

All viable habitat will be identified for the lessee/ operator by the Authorized Officer of the BLM during the preliminary environmental review of the proposed surface use plan. If the field examination indicates that

the proposed activity may affect the species, then consultation will be conducted with the U.S. Fish & Wildlife Service pursuant to Sec. 7 of the Endangered Species Act of 1973, as amended. The consultation will determine whether or not the proposed activity would jeopardize the continued existence of the species, and, if so, the extent, if any, the proposed activity will be allowed.

Authority: The Endangered Species Act of 1973, Peregrine Falcon Recovery Plan.

Notice

Wildlife - Bald Eagle Nest and Roost Sites and Associated Habitat

The leased lands are in an area suitable for the habitat of the Bald Eagle *(Haliaeetus leucocephalus)*, an animal species that is officially listed (Federal) as a Threatened species.

All viable habitat will be identified for the lessee/operator by the Authorized Officer of the BLM during the preliminary environmental review of the proposed surface use plan. If the field examination indicates that the proposed activity may affect the species, then consultation will be conducted with the U.S. Fish & Wildlife Service pursuant to Sec. 7 of the Endangered Species Act of 1973, as amended. The consultation will determine whether or not the proposed activity would jeopardize the continued existence of the species, and, if so, the extent, if any, the proposed activity will be allowed.

Authority: The Endangered Species Act of 1973, Pacific Bald Eagle Recovery Plan.

Notice

Wildlife - Marbled Murrelet Nest Sites and Nesting Habitat

The leased lands are in an area suitable for the habitat of the Marbled Murrelet *(Brachyramphus marmoratus)*, an animal species that is proposed (Federal) as a Threatened species.

All viable habitat will be identified for the lessee/operator by the Authorized Officer of the BLM during the preliminary environmental review of the proposed surface use plan. If the field examination indicates that the proposed activity may affect the species, then consultation will be conducted with the U.S. Fish & Wildlife Service pursuant to Sec. 7 of the Endangered Species Act of 1973, as amended. The consultation will determine whether or not the proposed activity would jeopardize the continued existence of the species, and, if so, the extent, if any, the proposed activity will be allowed.

Authority: The Endangered Species Act of 1973.

Notice

Cultural Resources: An inventory of the leased lands may be required prior to surface disturbance to determine if cultural resources are present and to identify needed mitigation measures. Prior to undertaking any surface-disturbing activities on the lands covered by this lease, the lessee or operator shall:

1. Contact the Bureau of Land Management (BLM) to determine if a cultural resource inventory is required. If an inventory is required, then;
2. The BLM will complete the required inventory; or the lessee or operator, at their option, may engage the services of a cultural resource consultant acceptable to the BLM to conduct a cultural resource inventory of the area of proposed surface disturbance. The operator may elect to inventory an area larger than the standard ten-acre minimum to cover possible site relocation, which may result from environmental or other considerations. An acceptable inventory report is to be submitted to the BLM for review and approval no later than that time when an otherwise complete application for approval of drilling or subsequent surface-disturbing operation is submitted.
3. Implement mitigation measures required by the BLM. Mitigation may include the relocation of proposed lease-related activities or other protective measures such as data recovery and extensive recordation. Where impacts to cultural resources cannot be mitigated to the satisfaction of the BLM, surface occupancy on that area must be prohibited. The lessee or operator shall immediately bring to the attention of the BLM any cultural resources discovered as a result of approved operations under this lease, and shall not disturb such discoveries until directed to proceed by the BLM.

Authorities: Compliance with Section 106 of the National Historic Preservation Act is required for all actions which may affect cultural properties eligible to the National Register of Historic Places. Section 6 of the Oil and Gas Lease Terms (Form 3100-11) requires that operations be conducted in a manner that minimizes adverse impacts to cultural and other resources.

SPECIAL LEASING STIPULATIONS

The following special stipulations are to be utilized on specifically designated tracts of land as described under the various alternatives.

Leasing Stipulations Common To All Alternatives

No Surface Occupancy

Resource: Land Use Authorizations

Stipulation: Surface occupancy and use is prohibited on Recreation and Public Purposes (R&PP) and FLPMA leases.

Objective: To protect uses on existing R&PP and FLPMA leases.

Exception: An exception to this stipulation may be granted by the Authorized Officer, if the operator submits a plan demonstrating that impacts from the proposed action are acceptable or can be adequately mitigated.

Modification: The area affected by this stipulation may be modified by the Authorized Officer, if the land use authorization boundaries are modified.

Waiver: This stipulation may be waived by the Authorized Officer, if all land use authorizations within the leasehold have been terminated, canceled, or relinquished.

No Surface Occupancy

Resource: Recreation Sites

Stipulation: Surface occupancy and use are prohibited within developed recreation areas.

Objective: To protect developed recreation areas.

Exception: An exception to this stipulation may be granted by the Authorized Officer, if the operator submits a plan demonstrating that impacts from the proposed action are acceptable or can be adequately mitigated.

Modification: The boundaries of the stipulated area may be modified by the Authorized Officer, if the recreation area boundaries are changed.

Waiver: This stipulation may be waived, if the Authorized Officer determines that the entire leasehold no longer contains developed recreation areas.

No Surface Occupancy

A 30-day public notice period will be required prior to modification or waiver of this stipulation.

Resource: Special Areas

Stipulation: Surface occupancy and use are prohibited within Areas of Critical Environmental Concern (ACEC).

Objective: To protect important historic, cultural, scenic values, natural resources, natural systems or processes, threatened and endangered plant species, and/or natural hazard areas of the ACEC.

Exception: An exception to this stipulation may be granted by the Authorized Officer, if the operator submits a plan demonstrating that impacts from the proposed action are acceptable or can be adequately mitigated.

Modification: The boundaries of the stipulated area may be modified by the Authorized Officer, if the ACEC or EEA boundaries are changed.

Waiver: This stipulation may be waived, if the Authorized Officer determines that the entire leasehold no longer contains designated ACECs or EEAs.

No Surface Occupancy

Resource: Progeny test sites.

Stipulation: Surface occupancy and use are prohibited within progeny test sites.

Objective: To protect progeny test sites.

Exception: None.

Modification: The boundaries of the stipulated area may be modified by the Authorized Officer, if the progeny test site boundaries are changed.

Waiver: This stipulation may be waived, if the Authorized Officer determines that the entire leasehold no longer contains progeny test sites.

No Surface Occupancy

A 30-day public notice period will be required prior to modification or waiver of this stipulation.

Resource: Visual Resource Management (VRM) Class I

Stipulation: Surface occupancy and use are prohibited in VRM Class I areas.

Objective: To preserve the existing character of the landscape.

Exception: An exception to this stipulation may be granted by the Authorized Officer, if the operator submits a plan demonstrating that impacts from the proposed action are acceptable or can be adequately mitigated.

Modification: The boundaries of the stipulated area may be modified by the Authorized Officer, if the boundaries of the VRM Class I area are changed.

Waiver: This stipulation may be waived by the Authorized Officer, if all VRM Class I areas within the leasehold are reduced to a lower VRM class. Areas reduced to VRM Class II will be subject to the Controlled Surface Use stipulation for visual resources, and areas reduced to VRM Class III will be subject to standard lease stipulations.

No Surface Occupancy

Resource: Wildlife - Bald Eagle Nest and Roost Sites and Associated Habitat

Stipulation: Surface occupancy and use are prohibited within one-half mile of known bald eagle nest and roost sites, which have been active within the past 7 years and within associated habitat.

Objective: To protect bald eagle nesting and roost sites and/or associated habitat in accordance with the Endangered Species Act (ESA), and the Pacific Bald Eagle Recovery Plan.

Exception: An exception may be granted by the Authorized Officer, if the operator submits a plan which demonstrates that the proposed action will not affect the bald eagle or its habitat. If the Authorized Officer determines that the action may or will have an adverse effect on the species, the operator may submit a plan demonstrating that the impacts can be adequately mitigated. This plan must be approved by BLM in consultation with the U.S. Fish and Wildlife Service (USFWS).

Modification: The boundaries of the stipulated area may be modified, if the Authorized Officer, in consultation with USFWS, determines that portion of the area can be occupied without adversely affecting bald eagle nest and roost sites or associated habitat.

Waiver: This stipulation may be waived if the Authorized Officer, in consultation with USFWS, determines that the entire leasehold can be occupied without adversely affecting bald eagle nest or roost sites, associated habitat, or if the bald eagle is declared recovered and is no longer protected under the ESA.

No Surface Occupancy

Resource: Wildlife - Marbled Murrelet Nest Sites

Stipulation: Surface occupancy and use are prohibited within one-quarter mile of known marbled murrelet nest sites, which have been active within the past 7 years.

Objective: To protect marbled murrelet nesting sites.

Exception: An exception may be granted by the Authorized Officer, if the operator submits a plan which demonstrates that the proposed action will not affect the marbled murrelet or its nest site. If the authorized officer determines that the action may or will have an adverse effect on the species, the operator may submit a plan demonstrating that the impacts can be adequately mitigated. This plan must be approved by BLM.

Modification: The boundaries of the stipulated area may be modified if the Authorized Officer, in consultation with USFWS, determines that portion of the area can be occupied without adversely affecting marbled murrelet nest sites.

Waiver: This stipulation may be waived, if the Authorized Officer determines that the entire leasehold can be occupied without adversely affecting marbled murrelet nest sites.

Controlled Surface Use

Resource: Soils

Stipulation: Prior to disturbance of any suspected unstable slopes or slopes over 60 percent, an engineering/reclamation plan must be approved by the Authorized Officer. Such plan must demonstrate how the following will be accomplished:

- Site productivity will be restored.
- Surface runoff will be adequately controlled.
- Off-site areas will be protected from accelerated erosion, such as rilling, gullying, piping, and mass wasting.
- Water quality and quantity will be in conformance with state and federal water quality laws.

- Surface-disturbing activities will not be conducted during extended wet periods.
- Construction will not be allowed when soils are frozen.

Objective: To maintain soil productivity, provide necessary protection to prevent excessive soil erosion on steep slopes, and to avoid areas subject to slope failure, mass wasting, piping, or having excessive reclamation problems.

Exception: An exception to this stipulation may be granted by the Authorized Officer if the operator submits a plan, which demonstrates that the impacts from the proposed action are acceptable or can be adequately mitigated.

Modification: The area affected by this stipulation may be modified by the Authorized Officer, if it is determined that portions of the area do not include suspected unstable slopes or slopes over 60 percent.

Waiver: This stipulation may be waived by the Authorized Officer if it is determined that the entire leasehold does not include any suspected unstable slopes or slopes over 60 percent.

Controlled Surface Use

A 30-day public notice period will be required prior to modification or waiver of this stipulation.

Resource: Visual Resource Management (VRM) Class II.

Stipulation: All surface-disturbing activities, semipermanent and permanent facilities in VRM Class II areas may require special design including location, painting and camouflage to blend with the natural surroundings and meet the visual quality objectives for the area.

Objective: To control the visual impacts of activities and facilities within acceptable levels.

Exception: None.

Modification: None.

Waiver: This stipulation may be waived, if the Authorized Officer determines that there are no longer any VRM Class II areas in the leasehold.

No Additional Leasing Stipulations for the No Action Alternative

No Additional Leasing Stipulations for Alternative A

Additional Leasing Stipulations for Alternative B

Controlled Surface Use

Resource: Designated Mature and Old-Growth Forest Seral Stage Blocks

Stipulation: Unless otherwise authorized, drill site construction and access through designated mature and old-growth forest blocks within this leasehold will be limited to established roadways.

Objective: To protect vegetation to retain and/or restore older forests for seral stage diversity.

Exception: An exception to this stipulation may be granted by the Authorized Officer, if the operator submits a plan which demonstrates that impacts from the proposed action are acceptable or can be adequately mitigated.

Modification: The area affected by this stipulation may be modified by the Authorized Officer, if it is determined that portions of the area do not include designated mature and old-growth forest blocks.

Waiver: This stipulation may be waived by the Authorized Officer, if it is determined that the entire leasehold no longer includes designated mature and old-growth forest blocks.

Controlled Surface Use

Resource: Riparian Management Areas.

Stipulation: Unless otherwise authorized, drill site construction and access through riparian management areas within this leasehold will be limited to established roadways.

Objective: To protect riparian vegetation and reduce sedimentation.

Exception: An exception to this stipulation may be granted by the Authorized Officer, if the operator submits a plan which demonstrates that impacts from the proposed action are acceptable or can be adequately mitigated.

Modification: The area affected by this stipulation may be modified by the Authorized Officer, if it is determined that portions of the area do not include riparian areas, flood plains, or water bodies.

Waiver: This stipulation may be waived by the Authorized Officer, if it is determined that the entire leasehold no longer includes riparian management areas.

No Surface Occupancy

Resource: Riparian Management Areas.

Stipulation: Unless otherwise authorized, drill site construction and access through riparian management areas within this leasehold will be limited to established roadways.

Objective: To protect riparian vegetation and reduce sedimentation.

Exception: An exception to this stipulation may be granted by the Authorized Officer, if the operator submits a plan which demonstrates that impacts from the proposed action are acceptable or can be adequately mitigated.

Modification: The area affected by this stipulation may be modified by the Authorized Officer, if it is determined that portions of the area do not include riparian areas, flood plains, or water bodies.

Waiver: This stipulation may be waived by the Authorized Officer, if it is determined that the entire leasehold no longer includes riparian management areas.

Additional Leasing Stipulations for Alternative C

Controlled Surface Use

Resource: Old-Growth Restoration and Retention Blocks

Stipulation: Unless otherwise authorized, drill site construction and access through old-growth restoration and retention blocks within this leasehold will be limited to established roadways.

Objective: To protect vegetation, to retain and/or restore old-growth forest.

Exception: An exception to this stipulation may be granted by the Authorized Officer, if the operator submits a plan which demonstrates that impacts from the proposed action are acceptable or can be adequately mitigated.

Modification: The area affected by this stipulation may be modified by the Authorized Officer, if it is determined that portions of the area do not include old-growth restoration and retention blocks.

Waiver: This stipulation may be waived by the Authorized Officer, if it is determined that the entire leasehold no longer includes old-growth restoration and retention blocks.

Additional Leasing Stipulations for Alternative D

Controlled Surface Use

Resource: Habitat Conservation Areas for the Northern Spotted Owl.

Stipulation: Unless otherwise authorized, drill site construction and access through habitat conservation areas within this leasehold will be limited to established roadways.

Objective: To protect habitat of the Northern Spotted Owl.

Exception: An exception to this stipulation may be granted by the Authorized Officer, if the operator submits a plan which demonstrates that impacts from the proposed action are acceptable or can be adequately mitigated.

Modification: The area affected by this stipulation may be modified by the Authorized Officer, if it is determined that portions of the area do not include habitat conservation areas.

Waiver: This stipulation may be waived by the Authorized Officer, if it is determined that the entire leasehold no longer includes habitat conservation areas, after consultation with the U.S. Fish and Wildlife Service.

Additional Leasing Stipulations for Alternative E

Controlled Surface Use

Resource: Forest stands older than 150 years.

Stipulation: Unless otherwise authorized, drill site construction and access through forest stands older than 150 years within this leasehold will be limited to established roadways.

Objective: To protect older forest stands.

Exception: An exception to this stipulation may be granted by the Authorized Officer, if the operator submits a plan which demonstrates that impacts from the proposed action are acceptable or can be adequately mitigated.

Modification: The area affected by this stipulation may be modified by the Authorized Officer, if it is determined that portions of the area do no include old forest stands.

Waiver: This stipulation may be waived by the Authorized Officer, if it is determined that the entire leasehold no longer includes old forest stands.

Additional Leasing Stipulations for the Preferred Alternative

No Surface Occupancy

Resource: Wildlife - Osprey Nest Sites

Stipulation: Surface occupancy and use is prohibited within one-quarter mile of known osprey nest sites, which have been active within the past 7 years.

Objective: To protect osprey nest sites.

Exception: An exception may be granted by the Authorized Officer, if the operator submits a plan which demonstrates that the proposed action will not affect the osprey or its nest site. If the Authorized Officer determines that the action may or will have an adverse effect on the species, the operator may submit a plan demonstrating that the impacts can be adequately mitigated. This plan must be approved by BLM.

Modification: The boundaries of the stipulated area may be modified, if the Authorized Officer determines that portion of the area can be occupied without adversely affecting the osprey or its nest site.

Waiver: This stipulation may be waived, if the Authorized Officer determines that the entire leasehold can be occupied without adversely affecting osprey or osprey nest sites.

Controlled Surface Use

Resource: Riparian Management Areas.

Stipulation: Unless otherwise authorized, drill site construction and access through riparian management areas within this leasehold will be limited to established roadways.

Objective: To protect riparian vegetation and reduce sedimentation.

Exception: An exception to this stipulation may be granted by the Authorized Officer, if the operator submits a plan which demonstrates that impacts from the proposed action are acceptable or can be adequately mitigated.

Modification: The area affected by this stipulation may be modified by the Authorized Officer, if it is determined that portions of the area do not include riparian areas, flood plains, or water bodies.

Waiver: This stipulation may be waived by the Authorized Officer, if it is determined that the entire leasehold no longer includes riparian management areas.

Controlled Surface Use

Resource: Old-Growth Emphasis Area and Connectivity Areas

Stipulation: Unless otherwise authorized, drill site construction and access through old-growth emphasis area and connectivity areas within this leasehold will be limited to established roadways.

Objective: To protect vegetation, to retain and/or restore old-growth forest.

Exception: An exception to this stipulation may be granted by the Authorized Officer, if the operator submits a plan which demonstrates that impacts from the proposed action are acceptable or can be adequately mitigated.

Modification: The area affected by this stipulation may be modified by the Authorized Officer, if it is determined that portions of the area do not include old-growth emphasis area and connectivity areas.

Waiver: This stipulation may be waived by the Authorized Officer, if it is determined that the entire leasehold no longer includes old-growth emphasis area and connectivity areas.

Locatable Minerals Surface Management 43 CFR 3809 Standards for Exploration, Mining, and Reclamation in the Roseburg District

The following operational guidelines for mining activities have been compiled to assist the miner in complying with the 43 CFR 3809 regulations, which apply to all mining operations on BLM administered lands in the Roseburg District. The manner in which the necessary work is to be done will be site specific and all of the following standards may not apply to each mining operation. It is the mining claimant's and operator's responsibility to avoid "unnecessary or undue degradation" and they must perform all necessary reclamation work. Refer to 43 CFR 3809 regulations for general requirements. The BLM will provide site specific guidelines for some mining proposals.

Construction and Mining

Vegetation Removal

Remove only that vegetation which is in the way of mining activities. An application must be submitted to the Authorized Officer pursuant to 43 CFR 3821.4 describing the proposed use of merchantable timber for mining purposes. Merchantable timber may not be used for firewood. The Roseburg District BLM recommends that small trees (less than 6 inches dbh) and shrubs be lopped and scattered, or shredded for use as mulch. Trees over 12 inches breast height (dbh) are to be bucked and stacked in an accessible location unless they are needed for the mining operation.

Firewood

Firewood permits may be issued to the operator from designated firewood areas or from special request areas at the BLM's discretion.

Topsoil

All excavations should have all productive topsoil (usually the top 12 to 18 inches) first stripped, stockpiled and protected from erosion for use in future reclamation. This also includes removal of topsoil before the establishment of mining waste dumps and tailings ponds if the waste material will be left in place during reclamation.

Roads

Existing roads and trails should be used as much as possible. Temporary roads are to be constructed to a minimum width and with minimum cuts and fills. All roads shall be constructed so as not to negatively impact slope stability.

Wetlands

When proposed mining activities will fill or alter wetland areas, the operator must contact the Department of the Army, Corps of Engineers for the appropriate permit. A copy of the permit must be submitted to the BLM geologist in conjunction with a Notice or Plan of Operations.

Water Quality

When mining will be in or near bodies of water, or sediment (or other pollutants) will be discharged, contact the Department of Environmental Quality. It is the operator's responsibility to obtain any needed suction dredging, stream bed alteration, or water discharge permits required by the DEQ or other State agencies. Copies of such permits shall be provided to the BLM geologist when a Notice or Plan of Operations is filed.

Claim Monuments

Due to a new State law, plastic pipe is no longer allowed for claim staking in Oregon. It is BLM policy that mining claims with existing plastic pipe monuments should have all openings permanently closed. Upon loss or abandonment of the claim, all plastic pipe must be removed from the public lands and, when old markers are replaced during normal claim maintenance, they are to be either wood posts or stone or earth mounds, consistent with state law.

Drill Sites

Exploratory drill sites should be located next to or on existing roads when possible without blocking public access. When drill sites must be constructed, the size of the disturbance shall be as small as possible in order to conduct drilling operations.

Dust and Erosion Control

While in operation, and during periods of temporary shut-down, exposed ground surfaces susceptible to erosion will need to be protected. This can be accomplished with seeding, mulching, installation of water diversions, and routine watering of dust producing surfaces.

Fire Safety

All State fire regulations must be followed, including obtaining a campfire permit or blasting permit if needed. All internal combustion engines must be equipped with approved spark arresters.

Safety and Public Exclusion

Under Public Law 167, the Government has the right to dispose and manage surface resources (including timber) on mining claims located after July 23, 1955. These rights are limited to the extent that they do not endanger or materially interfere with any phase of an active mining operation or uses reasonably incident thereto.

The general public may not be excluded from the mining claim. In the interest of safety, the general public can be restricted only from specific dangerous areas (underground mines, open pits or heavy equipment) by erecting fences, gates and warning signs. It is the operator's responsibility to protect the public from mining hazards. Gates or road blocks may be installed on existing or proposed roads only with BLM approval.

Sewage

Self-contained or chemical toilets are to be used at active mining operations and their contents disposed of at approved dump stations. Outhouses and uncontained pit toilets are not allowed.

Occupancy

Occupancy or camping on public land, in excess of 14 days per calendar year, must be reasonably incident to and required for actual continuous mining or diligent exploration operations and will require either a Notice or Plan of Operations.

Only those persons actively involved in the mining operation or exploration work will be allowed to stay on the claim beyond the 14-day camping limit. Active operations are defined as a 40-hour work week (between 9 a.m. and 5 a.m., Monday through Friday). If operations cannot be actively pursued due to high fire danger in forested areas, then occupancy of the mine site will not be permitted.

Due to high water levels in streams and creeks during the fall and winter months, placer mining with hand tools and suction dredges historically has been too sporadic to warrant full time occupancy at mine sites. Therefore, mining claim occupancy for such operations is only permitted between May 15 to November 15. Other out-of- stream mining ventures may warrant occupancy beyond November 15, and will be evaluated on a case-by-case basis.

Structures

Structures including, but not limited to, plastic covered shelters, wooden or metal shacks or buildings will not be allowed for exploratory operations or for suction dredge mining operations. For other types of commercial operations, the need for structures will be evaluated on a case-by-case basis and, if they are found necessary for the mining operation, they should be temporary in nature.

Pets

If the operator proposes to have dogs or other pets at the site, all animals must be leashed. Under no circumstances are pets to be allowed to run free at mining sites or associated camp sites.

Suction Dredging

Filing either Notice or Plan of Operations is required on all suction dredge operations regardless of the size of the equipment. The operator must have the applicable Department of Environmental Quality suction dredge permit prior to starting work, and a copy should be submitted to the District Geologist.

Tailings Ponds

Settling ponds must be used to contain sediment and any discharge into creeks must meet the Department of Environmental Quality standards.

Gates

Gates restricting public access onto a mine site will only be considered in such cases where there is a large area safety hazard created by the mining activity or were it is considered absolutely necessary to protect property or resources. Fences (rather than gates) may be utilized to protect the public from hazards related to small excavations, adits, and shafts.

Trash & Garbage

Trash, garbage, used oil, etc. must be removed from public land and disposed of properly. Do not bury any trash, garbage, or hazardous wastes on public lands. Accumulations of trash, debris, or inoperable equipment on public lands is viewed as unnecessary degradation and will not be tolerated.

Cultural and Paleontological Resources

Operators shall not knowingly alter, injure, or destroy any scientifically important paleontological (fossil) remains or any historical or archaeological site, structure, or object on federal lands. The operator shall immediately bring to the attention of the Authorized Officer, any paleontological (fossil) remains or any historical or archaeological site, structure, or object that might be altered or destroyed by exploration or mining operations, and shall leave such discovery intact until told to proceed by the Authorized Officer. The Autho-

rized Officer shall evaluate the discovery, take action to protect or remove the resource, and allow operations to proceed within 10 working days.

Threatened and Endangered Species of Plants and Animals

Operators shall take such action as may be needed to prevent adverse impacts to Threatened or Endangered species of plants and animals and their habitat that may be affected by operations, as stipulated in guidelines developed through consultation with the U.S. Fish and Wildlife Service. Special status species (federal candidate/Bureau sensitive) plants and animals, and their habitat will be identified by the Authorized Officer, and shall be avoided wherever possible.

Reclamation

Reclamation of all disturbed areas must be performed concurrently or as soon as possible after mining permanently ceases. Reclamation shall include, but shall not be limited to: 1) saving topsoil for final application after reshaping disturbed areas; 2) measures to control erosion, landslides, and water runoff; 3) measures to isolate, remove or control toxic materials; 4) reshaping the area disturbed, applying topsoil, and revegetating disturbed areas where reasonably practicable; and 5) rehabilitation of fisheries and wildlife habitat. When reclamation of the disturbed area has been completed, except to the extent necessary to preserve evidence of mineralization, the BLM must be notified so that an inspection of the area can be made.

Equipment and Debris

All mining equipment, vehicles, structures, debris and trash must be removed from the public lands during periods of nonoperation and/or at the conclusion of mining, unless authorization from BLM is given to the operator or claimant in writing.

Backfilling and Recontouring

The first steps in reclaiming a disturbed site are backfilling excavations and reducing high walls. Coarse rock material should be replaced first, followed by medium sized material, with fine materials to be placed on top. Recontouring means shaping the disturbed area so that it will blend in with the surrounding lands and minimize the possibility of erosion, and facilitate revegetation.

Seedbed Preparation

Recontouring should include preparation of an adequate seedbed. This is accomplished by ripping or disking compacted soils to a depth of at least six inches in rocky areas and at least 12 inches in less rocky areas. This should be done following the contour of the land to limit erosion. All stockpiled settling pond fines, and then topsoil, are spread evenly over the disturbed areas. Further details are provided in BLM 3042 Manual and Reclamation Handbook.

Fertilizer

Due to the poor nutrient value of mined soils, it is important to use fertilizer to insure maximum yield from the seeding mixture. The fertilizer (16-16-16) should be spread at the rate of 200 lbs/acre, but not allowed to enter streams or bodies of water.

Seeding

BLM approved seeding prescription must be used to provide adequate revegetation for erosion control, wildlife habitat, and productive secondary uses of public lands. Seeding must be done in September or October to ensure that seed is in the ground prior to the first significant winter rains.

Broadcast seeding is preferable on smaller sites. When using a whirlybird type seed spreader, it is important to keep the different seeds well mixed to achieve even seed distribution. For the best results, a drag harrow should be pulled over the seeded area to cover the seed before mulching. Hydroseeding can be used on critical sites for rapid cover and erosion control on cut banks, fill slopes and any other disturbed areas.

Tree Replacement

Replacement of destroyed trees may be necessary with the planting of seedlings or container stock.

Mulch

As directed by the BLM, during review of the Notice or Plan of Operations, the disturbed area may require mulching during interim or final reclamation procedures. Depending on site conditions, the mulch may need to be punched, netted, or blown on with a tackifier to hold it in place. In some cases, erosion control blankets may be cost effective for use.

Roads

After mining is completed, all new roads shall be reclaimed, unless otherwise specified by the BLM. High walls and cutbanks are to be knocked down or backfilled to blend with the surrounding landscape. Remove all culverts from drainage crossings and cut back the fill to the original channel. The roadbed should be ripped to a minimum depth of 12 inches to reduce compaction and provide a good seedbed. The road must then be fertilized, seeded and mulched if necessary. When necessary, water bars are to be used to block access and provide drainage.

Tailings Ponds

The ponds should be allowed to dry out and the sediments removed and spread with the topsoil, unless the sediments contain toxic materials. If the ponds contain toxic materials, a plan will be developed to identify, dispose, and mitigate effects of the toxic materials. If necessary, a monitoring plan will also be implemented. The ponds should then be backfilled and reclaimed.

Guidelines for Development of Salable Mineral Resources in the Roseburg District

Proposed Operations

All proposed salable mineral developments, and any exploration that involves surface disturbance, should have operation and reclamation plans approved by the Authorized Officer. All proposals will undergo the appropriate level of review and compliance with the National Environmental Policy Act.

Quarry Design

Due to steep terrain in the operating area, most quarry developments would require a series of benches to effectively maximize the amount of mineral materials to be removed in a safe manner. In all cases, bench height shall not exceed 40 feet. If the bench would be used by bulldozers to access other parts of the quarry, the width of the bench should be at least 25 feet. If the bench won't used by equipment, then this width can be reduced to approximately 10 feet.

Clearing of timber and brush should be planned at least 10 feet beyond the edge of the excavation limit. Most often the brush would be piled and burned at the site, or scattered nearby.

If at all possible, all topsoil and overburden should be stockpiled and saved for eventual quarry site reclamation. These piles may need to be stabilized by mulching or seeding in order to minimize erosion during the winter months.

As a standard procedure, the excavation of the quarry floor should be designed with an outslope of approximately two percent in order to provide for adequate drainage of the floor. Compliance with this design should be made a requirement of all operators at the site.

Operating Procedures

Where practicable, the following requirements should be made a part of every contract or permit providing for the use of mineral material sites on the district:

- Oversized boulders shall not be wasted, but shall be broken and utilized concurrently with the excavated material unless otherwise specified.
- The operator shall comply with local and State safety codes covering quarry operations, warning signs and traffic control. All necessary permits must be obtained from State and County agencies.
- Use of the site for equipment storage and stockpiling rock material is allowed for the duration of the contract or permit. Use of the site beyond that time would be authorized under a temporary use permit.
- All topsoil shall be stockpiled or windrowed as appropriate, for use in reclamation.
- Prior to abandonment, all material sites will be graded to conform with the surrounding topography. Topsoil will be utilized to create a medium for revegetation. Reseeding and tree planting, if necessary, will be done as prescribed by the Authorized Officer. Access roads no longer needed by the BLM will be abandoned and reclaimed as directed by the Authorized Officer.

Appendix 2-8
Management Guidelines and Standards for National Wild and Scenic Rivers

The Wild and Scenic Rivers Act (Public Law 90-542 as amended) established a method for providing Federal protection for certain of our remaining free flowing rivers, and preserving them and their immediate environments for the use and enjoyment of present and future generations. Rivers are included in the system so that they may benefit from the protective management and control of development for which the Act provides. The following guidelines and standards are extracted in part from the February 3, 1970, and August 26, 1982, joint Department of the Interior and Department of Agriculture guidelines. They would apply to formally designated rivers through incorporation in formal management plans, which are normally developed within three years of designation. The guidelines also apply, on an interim basis, to BLM administered lands along BLM study rivers, as well as other rivers or river segments that have been found by the Bureau to be eligible for consideration as components of the National Wild and Scenic River (W&SR) System. In the latter instance, interim application of the guidelines will continue until lifted by a determination of nonsuitability through BLM's planning (RMP) process or by Congressional action.

Section 10(a) of the Act states that:

> "Each component of the National Wild and Scenic Rivers System (WSR) shall be administered in such a manner as to protect and enhance the values which caused it to be included in said system without, insofar as is consistent therewith, limiting other uses that do not substantially interfere with public use and enjoyment of these values. In such administration, primary emphasis shall be given to protecting its aesthetic, scenic, historic, and scientific features. Management plans for any such component may establish varying degrees of intensity for its protection and development, based on the special attributes of the area."

This section is interpreted by the Secretaries of the Interior and Agriculture as stating a nondegradation and enhancement policy for all designated river areas, regardless of classification.

The Congress with Presidential approval may determine which river segments will be added to the WSR System. When a river is designated, and BLM is identified as the administering Federal agency, BLM will establish administrative boundaries to protect the identified Outstandingly Remarkable Values. By law, the land inside the boundaries normally may not exceed an average of 320 acres per river mile over the designated portion of the river. BLM would delineate boundaries based on natural or man-made features (canyon rims, roads and ridgetops, etc.) and with consideration of legally identifiable property lines.

A river management plan must be also completed by the administering Federal agency, within three years after designating legislation. Existing State, local and Federal laws continue in effect during the interim along with general Department of Interior guidelines. If Federal designation overlaps State Scenic Waterway designation, a joint Federal/State management plan would be developed. All management plans will address the roles of Federal, State, County, and relevant Indian tribal governments in management of the river.

Discussion of BLM's inventory to determine which river stretches are eligible for consideration as components of the system is presented in Chapter 3 and Appendix 2-9. Also included in that appendix are discussions of the criteria for eligibility for each classification (wild, scenic, recreational) for which any river reviewed has been found eligible and the results of BLM's eligibility studies.

The guidelines that follow are presented for each separate river classification (recreational, scenic, and wild).

Recreational River Areas

Recreational river areas are defined by the Act to be "Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past."

Management Objective for Recreational River Areas

Management of recreational river areas should give primary emphasis to protecting the values which make it an Outstandingly Remarkable Value while providing river- related outdoor recreation opportunities in a recreational setting. Recreational classification is a determination of the level of development and does not prescribe or assume recreation development or enhancement. Management of recreational river areas can and should maintain and provide outdoor recreation opportunities. The basic distinctions between a "scenic" and a "recreational" river area are the degree of access, extent of shoreline development, historical impoundment or diversion, and types of land use. In general, a variety of agricultural, water management, silvicultural, recreational, and other practices or structures are compatible with recreational river values, providing such practices or structures are carried on in such a way that there is no substantial adverse effect on the river and its immediate environment.

Management Standards for Recreational River Areas

Recreation facilities may be established in proximity to the river, although recreational river classification does not require extensive recreational developments. Recreational facilities may still be kept to a minimum, with visitor services provided outside the river area. Future construction of impoundments, diversions, straightening, riprapping, and other modification of the waterway or adjacent lands would not be permitted except in instances where such developments would not have a direct and adverse effect on the river and its immediate environment. The following program management standards apply:

1. Forestry Practices: Forestry practices including timber harvesting would be allowed under standard restrictions to avoid adverse effects on the river environment and its associated values.

2. Hydroelectric Power and Water Resource Development: No development of hydroelectric power facilities would be permitted. Existing low dams, diversion works, riprap and other minor structures may be maintained provided the waterway remains generally natural in appearance. New structures may be allowed provided that the area remains generally natural in appearance and the structures harmonize with the surrounding environment.

3. Mining: Subject to existing regulations (e.g., 43 CFR 3809) and any future regulations that the Secretary of the Interior may prescribe to protect values of rivers included in the WSR System; new mining claims are allowed and existing operations are allowed to continue. All mineral activity on Federally administered land must be conducted in a manner that minimizes surface disturbance, water sedimentation and pollution, and visual impairment. Reasonable mining claim and mineral lease access will be permitted. Mining claims, subject to valid existing rights, within the recreational river area boundary can be patented only as to the mineral estate and not the surface estate (subject to proof of discovery prior to the effective date of designation).

4. Road and Trail Construction: Existing parallel roads can be maintained on one or both river banks. There can be several bridge crossings and numerous river access points. Roads, trails, and visitor areas must conform to construction and maintenance standards and be free of recognized hazards.

5. Agricultural Practices and Livestock Grazing: Lands may be managed for a full range of agriculture and livestock grazing uses, consistent with current practices.

6. Recreation Facilities: Interpretive centers, administrative headquarters, campgrounds and picnic areas may be established in proximity to the river. However, recreational classification does not require extensive recreation development.

7. Public Use and Access: Recreation use including, but not limited to, hiking, fishing, hunting, and boating is encouraged in recreational river areas to the extent consistent with the protection of the river environment. Public use and access may be regulated and distributed where necessary to protect and enhance recreational river values. Any new structures must meet established safety and health standards or in their absence be free of any recognized hazard.

8. Rights-of-Way: New transmission lines, natural gas lines, water lines, etc., are discouraged unless specifically prohibited outright by other plans, orders and laws. Where no reasonable alternate location exists, additional or new facilities should be restricted to existing rights-of-way. Where new rights-of-way are unavoidable, locations and construction techniques will be selected to minimize adverse effects on recreational river area related values and fully evaluated during the site selection process.

9. Motorized Travel: Motorized travel on land will generally be permitted, on existing roads. Controls will usually be similar to that of surrounding lands. Motorized travel on water will be in accordance with existing regulations or restrictions.

10. Instream Flow Assessment: To the extent practical, consistent with resource management objectives, quantify instream flow and protection requirements related to Outstandingly Remarkable and other resource values identified through the RMP process. Where possible, conduct a comprehensive, interdisciplinary, resource value-based assessment in order to delineate resource values, relate flows to resource conditions, and formulate flow protection strategies that incorporate legal, technical, and administrative aspects in order to secure instream flows which address values associated with the recreational river segment.

Scenic River Areas

Scenic river areas are defined by the Act to be "Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads."

Management Objective for Scenic River Areas

Management of scenic river areas should maintain and provide outdoor recreation opportunities in a near natural setting. In general, a wide range of agricultural, water management, silvicultural and other practices or structures could be compatible with scenic river values, providing such practices or structures are carried on in such a way that there is no substantial adverse effect on the river and its immediate environment.

Management Standards for Scenic River Areas

The same limitations set forth for recreational river areas are applicable, except that developments should harmonize with the environment, and developments on shore lands should be screened from the river. The following program management standards apply:

1. Forestry Practices: Silvicultural practices including timber harvesting could be allowed provided that such practices are carried on in such a way that there is no substantial adverse effect on the river and its immediate environment. The river area should be maintained in its near natural condition. Timber outside the boundary, but within the visual seen area, should be managed and harvested in a manner which provides special emphasis on visual quality. Preferably, reestablishment of tree cover would be through natural revegetation. Cutting of dead and down materials for fuelwood should be limited. Where necessary, restrictions on use of wood for fuel may be prescribed.

2. Hydroelectric Power and Water Resource Development: No development of hydroelectric power facilities would be permitted. Flood control dams and levees would be prohibited. All water supply dams and major diversions are prohibited. Maintenance of existing facilities and construction of some new structures would be permitted provided that the area remains natural in appearance and the practices or structures harmonize with the surrounding environment.

3. Mining: Subject to existing regulations (e.g., 43 CFR 3809) and any future regulations that the Secretary of the Interior may prescribe to protect the values of rivers included in the WSR System; new mining claims are allowed and mineral leases can be allowed. All mineral activity on Federally administered land must be conducted in a manner that minimizes surface disturbance, water sedimentation and pollution, and visual impairment. Reasonable mining claim and mineral lease access will be permitted. Mining claims, subject to valid existing rights, within the scenic river area boundary can be patented only as to the mineral estate and not the surface estate (subject to proof of discovery prior to the effective date of designation).

4. Road and Trail Construction: Roads or trails may occasionally bridge the river area and short stretches of conspicuous roads or long stretches of inconspicuous and well-screened roads could be allowed. Maintenance of existing roads and trails, and any new roads or trails, will be based on the type of use for which the roads or trails are constructed and the type of use that will occur in the river area.

5. Agricultural Practices and Livestock Grazing: A wide range of agricultural and livestock grazing uses is permitted to the extent currently practiced. Row crops are not considered as an intrusion of the "largely primitive" nature of scenic corridors as long as there is not a substantial adverse effect on the natural-like appearance of the river area.

6. Recreation Facilities: Larger-scale public use facilities, such as moderate-sized campgrounds, interpretive centers, or administrative headquarters are allowed if such facilities are screened from the river.

7. Public Use and Access: Recreation use including, but not limited to, hiking, fishing, hunting, and boating is encouraged in scenic river areas to the extent consistent with the protection of the river environment. Public use and access may be regulated and distributed where necessary to protect and enhance scenic river values.

8. Rights-of-Way: New transmission lines, natural gas lines, etc., are discouraged unless specifically authorized by other plans, orders or laws. Where no reasonable alternative exists, additional or new facilities should be restricted to existing rights-of-way. Where new rights-of-way are unavoidable, locations and construction techniques will be selected to minimize adverse effects on scenic river area related values and fully evaluated during the site selection process.

9. Motorized Travel: Motorized travel on land or water may be permitted, prohibited or restricted to protect river values. Prescriptions for management of motorized use may allow for search and rescue and other emergency situations.

10. Instream Flow Assessment: To the extent practical, consistent with resource management objectives, quantify instream flow and protection requirements related to Outstandingly Remarkable and other resource values identified through the RMP process. Where possible, conduct a comprehensive, interdisciplinary, resource value-based assessment in order to delineate resource values, relate flows to resource conditions, and formulate flow protection strategies which incorporate legal, technical, and administrative aspects in order to secure instream flows which address values associated with the scenic river segment.

Wild River Areas

Wild river areas are defined by the Act to include "Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America."

Management Objective for Wild River Areas

Management of wild river areas should give primary emphasis to protecting the values which make it Outstandingly Remarkable while providing river-related outdoor recreation opportunities in a primitive setting.

Management Standards for Wild River Areas

Allowable management practices might include construction of minor structures for such purposes as improvement of fish and game habitat; grazing; protection from fire, insects, or disease; and rehabilitation or stabilization of damaged resources, provided the area will remain natural appearing and the practices or structures are compatible and in harmony with the environment. Developments such as trail bridges, occasional fencing, natural-appearing water diversions, ditches, flow measurement or other water management devices, and similar facilities may be permitted if they are unobtrusive and do not have a significant direct and adverse effect on the natural character of the river area. The following program management standards apply:

1. Forestry Practices: Cutting of trees will not be permitted except when needed in association with a primitive recreation experience (such as clearing for trails) and for visitor safety or to protect the environment (such as control of fire). Timber outside the boundary, but within the visual corridors should, where feasible, be managed and harvested in a manner to provide special emphasis to visual quality.

2. Hydroelectric Power and Water Resource Development: No development of hydroelectric power facilities would be permitted. No new flood control dams, levees, or other works are allowed in the channel or river corridor. All water supply dams and major diversions are prohibited. The natural appearance and essentially primitive character of the river area must be maintained. Federal agency groundwater development for range, wildlife, recreation or administrative facilities may be permitted, if there are no adverse effects on river related Outstandingly Remarkable Values.

3. Mining: New mining claims and mineral leases are prohibited on Federal lands constituting the river bed or bank or located within 1/4 mile from the ordinary high water mark on both sides of the river.

Valid existing claims would not be abrogated and, subject to existing regulations (e.g., 43 CFR 3809) and any future regulations that the Secretary of the Interior may prescribe to protect the rivers included in the W&SR System, existing mining activity would be allowed to continue. All mineral activity on Federally administered land must be conducted in a manner that minimizes surface disturbance, water sedimentation, pollution, and visual impairment. Reasonable mining claim and mineral lease access will be permitted. Mining claims, subject to valid existing rights, within the wild river area boundary can be patented only as to the mineral estate and not the surface estate (subject to proof of discovery prior to the effective date of designation).

4. Road and Trail Construction: No construction of new roads, trails, or other provisions for overland motorized travel would be permitted within the river corridor. A few inconspicuous roads or unobtrusive trail bridges leading to the boundary of the river area may be permitted.

5. Agricultural Practices and Livestock Grazing: Agricultural use is restricted to a limited amount of domestic livestock grazing and hay production to the extent practiced prior to designation. Row crops are prohibited.

6. Recreation Facilities: Major public-use areas, such as campgrounds, interpretive centers, or administrative headquarters are located outside wild river areas. Simple comfort and convenience facilities, such as toilets, tables, fireplaces, shelters and refuse containers may be provided as necessary within the river area. These should harmonize with the surroundings. Unobtrusive hiking and horseback riding trail bridges could be allowed on tributaries, but would not normally cross the designated river.

7. Public Use and Access: Recreation use including, but not limited to, hiking, fishing, hunting and boating is encouraged in wild river areas to the extent consistent with the protection of the river environment. Public use and access may be regulated and distributed where necessary to protect and enhance wild river values.

8. Rights-of-Way: New transmission lines, natural gas lines, water lines, etc., are discouraged unless specifically authorized by other plans, orders or laws. Where no reasonable alternate location exists, additional or new facilities should be restricted to existing rights-of-way. Where new rights-of-way are unavoidable, locations and construction techniques will be selected to minimize adverse effects on wild river area related values and fully evaluated during the site selection process.

9. Motorized Travel: Motorized travel on land or water could be permitted, but it is generally not compatible with this river classification. Normally, motorized use will be prohibited in a wild river area. Prescriptions for management of motorized use may allow for search and rescue and other emergency situations.

10. Instream Flow Assessment: To the extent practical and consistent with resource management objectives, instream flows sufficient to meet the purposes of the designated WSR river should be protected and enhanced if possible. Based on the results of an instream flow assessment, implement flow protection strategies and actions that incorporate legal, technical, and administrative aspects in order to secure instream flow protection for applicable river segments. Protection strategies should be addressed and incorporated in river management plans.

Management Objectives Common to Wild, Scenic, and Recreational Rivers

Fire Protection and Suppression: Management and suppression of fires within a designated river area will be carried out in a manner compatible with contiguous Federal lands. On wildfires, suppression methods will be utilized that minimize long-term impacts on the river and river area. Presuppression and prevention activities will be conducted in a manner which reflects management objectives for the specific river segment. Prescribed fire may be used to maintain or restore ecological condition or meet objectives of the river management plan.

Insects, Diseases and Noxious Weeds: The control of forest and rangeland pests, diseases and noxious weed infestations will be carried out in a manner compatible with the intent of the Act and management objectives of contiguous Federal lands.

Cultural Resources: Historic and prehistoric resource sites will be identified, evaluated and protected in a manner compatible with the management objectives of the river and in accordance with applicable regulations and policies. Where appropriate, historic or prehistoric sites will be stabilized, enhanced and interpreted.

Water Quality: Water quality will be maintained or improved to meet Federal criteria or Federally approved state standards. (River management plans shall prescribe a process for monitoring water quality on a continuing basis.)

Fish and Wildlife Habitat Improvement: The construction and maintenance of minor structures for the protection, conservation, rehabilitation or enhancement of fish and wildlife habitat are acceptable provided they do not affect the free flowing characteristics of the WSR river, are compatible with the river's classification, that the area remains natural in appearance and the practices or structures harmonize with the surrounding environment.

Water Rights: In the process of evaluating river segments, authorizing officials are held to established principles of law with respect to water rights. Under provisions of Section 13 of the Act, as well as other statutes, river studies shall not interfere (except for licenses under Section 7(b) of the Act, pertaining to Section 5(a) WSR river studies) with existing rights, including the right of access, with respect to the beds of navigable streams, tributaries, or river segments. In addition, under the Federal Land Policy and Management Act and the Federal Power Act, the BLM has conditioning authority to control any proposed projects which would be incompatible or potentially degrading to river and/or other identified resource values.

Oregon Scenic Waterways Act

In 1969 the State of Oregon passed the Oregon Scenic Waterways Act. This legislation established a program that protects designated rivers throughout Oregon and is administered by the Oregon Department of Parks and Recreation. Its goals are to protect the free-flowing character of designated rivers for fish, wildlife and recreation. Dams, reservoirs, impoundments and placer mining are prohibited on state scenic waterways. The Act requires review of new development along designated rivers. It does not affect existing water rights, development or uses.

Management Constraints on Private Lands

Designation of a river under the Wild and Scenic Rivers Act gives the Federal government no authority to regulate or zone private lands. Land use controls on private lands are solely a matter of State and local zoning regulations. Although the WSR Act includes provisions encouraging the protection of river values through State and governmental land use planning, these provisions are not binding on local governments. The Federal government is responsible for assuring that designated rivers are managed in a manner which meets the intent of the WSR Act.

River management plans may prescribe land use or development limitations to protect a river's Outstandingly Remarkable Values. Many uses may be compatible with a wild, scenic, or recreational classification as long as the rivers are administered so as to protect and enhance the values which caused them to be included in the national system. Most existing uses and activities on adjoining private lands may continue. Timber harvest activities on private lands within a WSR boundary would continue to be regulated by the Oregon Forest Practices Act.

The primary consideration in any river or land use limitation would be the protection and enhancement of a designated river's Outstandingly Remarkable Value(s). BLM will work closely with landowners to assure that all uses will be consistent with the intent of the W&SR Act. Those uses that clearly threaten identified Outstandingly Remarkable Values would be addressed on a case-by-case basis.

Specific management goals for new building, other structure or road construction on private lands along designated rivers would be addressed through the individual river management plans. Federal guidelines allow different degrees of development along rivers classified as wild, scenic, or recreational. In consultation with landowners involved, every effort would be made to reduce adverse impacts to an acceptable level on proposals for major up-grading, realignment and/or new construction of roads. Maintenance of existing roads would generally not alter a river's condition and thus would not be restricted.

On designated rivers, BLM could negotiate with a landowner to purchase specific development rights necessary to prevent any threat to the river's identified Outstandingly Remarkable Values if all other efforts fail to reduce anticipated adverse impacts to an acceptable level. Another option, where mutually agreeable, would be a land exchange providing the private landowner with comparable lands outside the administrative boundary of a river.

The WSR Act specifically prohibits the use of condemnation in the fee title purchase of lands if 50 percent or more of the land within the boundary is already in public ownership. While the Act provides the Federal government with authority to purchase scenic, conservation or access easements through condemnation proceedings, this is considered to be a measure of last

resort. In the event condemnation was considered necessary, the only landowner rights purchased would be those considered necessary to prevent the threat to the river.

If BLM acquires an easement on private land, depending upon its terms and conditions, public access rights may or may not be involved. For example, a scenic easement could only involve the protection of narrowly defined visual qualities with no provisions for public use. A trail or road easement would involve public use provisions. Any provisions for public use of private lands must be specifically purchased from the landowner. BLM would work closely with landowners to minimize public use of nonfederal lands, through brochures, maps, signs and/or other appropriate means, except in locations where rights to such use are acquired.

WSR designation does not affect a private landowner's rights to control trespass. Landowners can charge a fee for crossing private lands to fish designated rivers except where a public access easement exists. The designation of a river into the National WSR system does not change landowner rights unless all or a portion of these use rights are acquired from the landowner.

On navigable rivers, the river bed and banks to the mean high water mark are state lands and are available under state laws for public use. Private landowners control public access to their property along the banks of non-navigable rivers. The designation of a river into the National WSR system has no bearing upon the determination of navigability.

Ownership and use of valid water rights are not affected by a WSR designation.

Appendix 2-9
Wild and Scenic River Eligibility and Classification Determinations

The first step in proposing additional rivers to the National System is to determine if the river is eligible. To qualify, a river must meet two criteria; (1) be free flowing and (2) have at least one outstanding remarkable value (ORV). These values are stated in the Wild and Scenic Rivers Act as, "scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values". The Rivers Act did not specifically spell out the criteria to judge these values. The BLM Westside Oregon Bureau Districts developed criteria (written up in Instruction Memorandum OR-89-632) which, in part, follows:

"A river's scenic, recreational, geologic, fish, wildlife, cultural, and/or historic value(s) are deemed "outstandingly remarkable" if one or more of the following guidelines apply to the value(s) under consideration.

Scenic - The landscape elements of landform, vegetation, water, color, influence of adjacent scenery, scarcity, and cultural modifications are unique and harmonious. The rating area must be scenic quality "A" as defined in the Visual Resource Inventory Handbook, H-8410-1, Illustrations 1 and 2 (included with this attachment). When analyzing scenic values, additional factors such as seasonal variations in vegetation, scale of cultural modifications, and length of time negative intrusions are viewed may be considered. Scenery and visual attractions may be highly diverse over the majority of the river or river segment length and not common to other rivers in the geographic region.

Recreational - Recreational opportunities are or have the potential to be unique enough to attract visitors from outside the geographic region. Visitors would be willing to travel long distances to use the river resources for recreational purposes. River-related opportunities could include, but not be limited to, sightseeing, wildlife observation, photography, hiking, fishing, hunting, and boating.

Interpretive opportunities may be exceptional and attract or have the potential to attract visitors from outside the geographic region.

The river may provide or have the potential to provide settings for national or regional commercial usage or competitive events.

Geologic - The river or the area within the river corridor contains an example(s) of a geologic feature, process, or phenomena that is rare, unusual, one-of-a-kind or unique to the geographic region. The feature(s) may be in an unusually active state of development, represent a "textbook" example and/or represent a unique or rare combination of geologic features (erosional, volcanic, glacial, and other geologic structures).

Fish - Fish values may be judged on the relative merits of either fish populations or habitat - or a combination of these river-related conditions:

Populations - The river is nationally or regionally one of the top producers or resident and/or anadromous fish species. Of particular significance is the presence of wild or unique stocks, or populations of federally listed or candidate threatened and endangered species.

Habitat - The river provides exceptionally high quality habitat for fish species indigenous to the region. Of particular significance is habitat for federally listed or candidate threatened and endangered species.

Wildlife - Wildlife values may be judged on the relative merits of either wildlife populations or habitat - or a combination of these conditions:

Populations - The river or river area within the river corridor contains nationally or regionally important populations of indigenous wildlife species dependent on the river environment. Of particular significance are species considered to be unique or populations or federally listed or candidate threatened and endangered species which are so dependent.

Habitat - The river or area within the river corridor provides a principal food source, unique habitation site, or migration route for wildlife of national or regional significance, or

for a federally listed or candidate threatened and endangered species. Contiguous habitat conditions are such that the biological need of the species are met.

Cultural - The river or area within the river corridor contains a site(s) where there is evidence of occupation or use by native Americans. Sites must be rare, one-of-a-kind, have unusual characteristics or exceptional human interest value(s). Sites may have national or regional importance for interpreting prehistory; may be rare and represent an area where a culture or cultural period was first identified and described; may have been used concurrently by two or more cultural groups; or may have been used by cultural groups for rare or sacred purposes.

Historic - The river or area within the river corridor contains a sites(s) or feature(s) associated with a significant event, an important person, or a cultural activity of the past that was rare, unusually or one-of-a-kind in the region. A historic site(s) and/or feature(s) in most cases is 50 years old or older. Of particular significance are sites or features listed in, or are eligible for inclusion in, the National Register of Historic Places.

Other Similar Values - While no specific evaluation guidelines have been developed for the "other similar values" category, it is assumed that districts will assess additional river-related values not covered in this attachment in a manner consistent with the foregoing guidance - including, but not limited to hydrologic, ecologic/biologic diversity, paleontologic, botanic, and scientific study opportunities."

After determining if a river segment is eligible for inclusion in the National Wild and Scenic River System, the next step in reviewing a potential river is to determine the potential classification. This is based on the condition of the river and the adjacent lands as they exist at the time of the study. Section 2 (b) of the Wild and Scenic Rivers Act provides three classifications. They are:

Wild - Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.

Scenic - Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.

Recreational - Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

The Federal Register, Vol. 47, No. 174, September 7, 1982, gives guidance for classifying rivers. It states that water quality, water resources development, shoreline development and accessibility are the criteria to be considered when determining classification. Each criterion is important, but their collective intent is more important. The basis for classification is the degree of naturalness of the river. The most natural rivers will be classified wild while the least natural rivers will be recreational.

Table 2-9-1 further defines the four criteria.

Table 2-9-1: Classification Criteria for Wild, Scenic, and Recreational Rivers

Attribute	Wild	Scenic	Recreational
Water Resources Development	Free of impoundment.	Free of impoundment.	Some existing impoundments or diversion. The existence of low dams, diversions or other modifications of the waterway is acceptable, provided the waterway remains generally natural and riverine in appearance.

Table 2-9-1: Classification Criteria for Wild, Scenic, and Recreational Rivers (cont.)

Attribute	Wild	Scenic	Recreational
Shoreline Development	Essentially primitive. Little or no evidence of human activity.	Largely primitive and undeveloped. No substantial evidence of human activity.	Some development. Substantial evidence of human activity.
	The presence of a few inconspicuous structures, particularly those of historic or cultural values, is acceptable.	The presence of small communities or dispersed dwellings or farm structures is acceptable.	The presence of extensive residential development and a few commercial structures is acceptable.
	A limited amount of domestic livestock grazing or hay production is acceptable.	The presence of grazing, hay production or row crops is acceptable.	Lands may have been developed for the full range of agricultural and forestry uses.
	Little or no evidence of past timber harvest. No ongoing timber harvest.	Evidence of past or ongoing timber harvest is acceptable, provided the forest appears natural from the riverbank.	May show evidence of past and ongoing timber harvest.
Water Quality	Meets or exceeds Federal criteria or federally approved State standards for aesthetics, for propagation of fish and wildlife normally adapted to the habitat of the river, and for primary contact recreation (swimming) except where exceeded by natural conditions.	No criteria prescribed the Wild and Scenic Rivers Act. The Federal Water Pollution Control Act Amendments of 1972 have made it a national goal that all waters of the United States be made fishable and swimmable. Therefore, rivers will not be precluded from scenic or recreational classification because of poor water quality at the time of their study, provided a water quality improvement plan exists or is being developed in compliance with applicable Federal and State laws.	
Accessibility	Generally inaccessible except by trail. No roads, railroads, or other provisions for vehicular travel within the river area. A few existing roads leading to the boundary of the river area is acceptable.	Accessible in places by road. Roads may occasionally reach or bridge the river The existence of short stretches of conspicuous or longer stretches of inconspicuous roads or railroads is acceptable.	Readily accessible by road or railroad. The existence of parallel roads or railroads on one or both banks as well as bridge crossings and other river access points is acceptable.

Source: The Federal Register, Vol. 47, No. 174, September 7, 1982.

Appendix 2-10 Wild and Scenic Rivers Suitability Assessments

This appendix contains suitability assessments for two of five river segments previously found eligible for inclusion in the National Wild and Scenic Rivers System (NWSRS). The three river segments found eligible but not assessed for suitability did not meet minimum suitability requirements. The primary reason for not assessing suitability on these segments is because BLM does not administer sufficient control, generally considered to be at least 40 percent of the study segment, to protect the values which made the rivers eligible. Two suitability assessments are attached (Canton Ck. and Smith River). This introduction to the individual suitability assessments, in addition to general background material, contains information on potential land acquisition, public involvement, suitability criteria, and comparative river segment quality that applies to each assessment.

The analysis of a river's potential for designation under the Nation Wild and Scenic Rivers Act involves three separate steps: determination of eligibility, classification, and suitability. Rivers or river segments can be classified as wild, scenic, or recreational river areas. Final designation decisions are made by Congress.

To be eligible for designation a river or river segment must be free-flowing and possess at least one outstandingly remarkable value. Eligibility and potential classification decisions were previously made in the planning process. These documents are on file at the Roseburg District Office. Appendix 2-9 contains eligibility and classification criteria used in that process. All river segments included in this appendix are within state comprehensive outdoor recreation (SCORP) region 9. Six streams were reviewed to fulfill analysis requirements for eligibility determination. A summary of eligibility and highest potential classification is shown in Chapter 3, Table 3-31. Suitability findings by alternative are described in Chapter 2.

Criteria specified in section 4(a) of the Wild and Scenic Rivers Act provides a basis for suitability assessment. These criteria are specifically addressed in the individual suitability assessments and are as follows:

1. The characteristics that do or do not make the area a worthy addition to the system.

2. The current status of land ownership and use in the area.

3. The reasonably foreseeable potential uses of the land and water which would be enhanced, foreclosed, or curtailed if the area were included in the National Wild and Scenic River System (NWSRS).

4. The federal agency which should administer the river.

5. The extent to which the costs thereof would be shared by state and local agencies.

6. And, the estimated cost to the United States of acquiring necessary land and interest in land and of administering the area, should it be added to the system.

In the Analysis of the Management Situation summary we stated a separate Legislative Environmental Impact Statement (LEIS) would be prepared for river or river segments found suitable for designation as a component of the NWSRS. The LEIS would have been the method of forwarding the findings and recommendations to Congress. However, we have now decided that this RMP/EIS will serve as the only EIS analyzing suitability findings and whatever recommendations are made later for inclusion in the system.

For river segments found eligible but not assessed for suitability and those assessed and found suitable, all BLM-administered land within one-quarter mile on either side of the river segments will be afforded a level of interim management necessary for protection of identified outstanding remarkable values (ORV). This interim management will continue until a final determination is made.

The federal government does not manage private land within designated wild, scenic, or recreational rivers areas and has no zoning authority over these lands

under the Act. The federal government's authority to affect private lands is primarily through the acquisition authorities conferred in the Wild and Scenic Rivers Act. Except for the acquisition of land or interest in lands, for which just compensation is made, the agencies cannot regulate the use of private property via this law. Section 6Ob) of the Wild and Scenic Rivers Act prohibits federal condemnation to purchase fee title lands when fifty percent or more of a designated river corridor is public land (federal, state, county, etc.). However, section 6Ob) does allow the use of condemnation to purchase scenic easements as a measure of last resort to remove or prevent a threat to the river or its ORVs.

Private land ownership is legitimate within designated river boundaries, and existing private land uses are often consistent with wild, scenic, or recreational rivers management goals. Carefully conducted ranching, farming, mining, and forest management activities within the "Scenic" and "Recreational" river classifications may continue. Assistance to private landowners may be provided by the federal government to encourage practices that enhance the river's natural values, e.g., water quality and quantity, streambank stability and riparian habitat.

There has been minimal public involvement concerning the suitability of rivers found eligible for potential designation. A concern was expressed about the process used for suitability determination, and how the analysis was to be made.

Based on planning criteria in the State Director's guidance for formulation of planning alternatives (see Appendix 1-5), BLM made a comparison of outstandingly remarkable values associated with each eligible river segment in each SCORP region. Rivers were found suitable for designation in the NWSRS in the different alternatives based on whether one or more of its ORVs were ranked at the top four (alternative D), top two (alternative C), or top one (alternative B) river(s) in its SCORP region. Rivers that are already included in the NWSRS were ranked equally as being among the top river(s) in the SCORP region.

Four designated rivers (the Rogue, upper Rogue, Illinois, and North Umpqua) and one Congressionally-mandated study river (the upper Klamath) flow through SCORP Region 9. Therefore, the ORVs associated with those rivers were ranked above those on non-designated rivers. The top four river areas per ORV, shown in Table 2-10-1, are listed below, with the top river(s) listed first. Fish was the sole ORV identified for both Canton Creek and Smith River. Neither segments ranked in the top four in the SCORP region for this ORV.

The following two suitability assessments contain a summary which identifies the river segment and the findings followed by a more detailed description of the river and other factors considered in the suitability determination.

Table 2-10-1 Ranking of Outstandingly Remarkable Values in Region 9.

River Segment	Rec.	Geol.	Fish	Wildlife	Scn.	Cult.	Hist.	Other[1]
Rogue[2]	X		X	X	X		X	
Illinois	X		X	X	X			X
Klamath[3]	X		X	X	X	X	X	X
N. Umpqua[2]	X		X		X			X
Upper Rogue[2]		X		X				X
Smith River			X					
Canton Creek			X					

[1]Other (water quality, hydrological, botanical, vegetation, ecological, biological, and diversity).
[2]River segments previously designated.
[3]The river Klamath ranks in the top one or two rivers for cultural, historic, and other ORVs.

Smith River

I. Summary

The 17.5 mile segment of Smith River from the confluence with the South Fork of Smith River to the western boundary of the resource area was studied to determine suitability for designation as a recreational river under the National Wild and Scenic Rivers Act.

II. Background

A. Description of the River

Smith River is a principal tributary of the Umpqua River. The Roseburg district office identified as eligible a 17.5 mile segment of Smith River from the confluence with the South Fork of Smith River, located in section 31, T.20S., R.6W., W.M. to the western boundary of the resource area in section 6, T.21 S., R.7 W., W.M.

Smith River provides important spawning and rearing habitat for anadromous fish species.

There are no campgrounds or hiking trails within the segment. Recreational opportunities for water sports are limited due to the stream morphology and limited flows. Newman Hole, a swimming area that gets very limited use by local residents, is within the study segment. Access to the river for recreational use is limited due to the steep banks and thick vegetation.

Portions of the study segment, a one-half mile corridor (one-quarter mile on each side of the stream), have been clearcut while other parts have old-growth coniferous forests. A County and BLM road parallels the river the entire length of the study area.

B. Eligibility Determination

Smith River is free-flowing within the 17.5 mile study segment. Resident and anadromous fish are the single outstandingly remarkable value (ORV) identified through eligibility assessment. This segment supports several native stocks of species of fish including; fall chinook salmon, coho salmon, winter steelhead, resident cutthroat trout, and sea run cutthroat trout. This suitability assessment was prepared based on these findings and BLM's fifty-five percent administrative jurisdiction along the one-half mile river corridor.

C. Classification Determination.

The river's highest potential classification is recreational as shown below. The river is free of any impoundments or diversions, however minor stream-bank modification has occurred from riprap placement and construction of bridge abutments. The Scenic Quality Class is C (low) and VRM Management Class on the available forest land would be VRM class IV if the river is found non-suitable for Wild and Scenic status. The non-available forest land would be classified as it is inventoried - VRM III. If the river is found suitable, on the other hand, the entire corridor would be classified as inventoried - that is VRM III.

Under VRM IV management, landscape alterations may dominate the view and may be the major focus of viewer attention. The scenic quality of the area may be significantly modified. Under VRM III management, landscape alterations may attract attention, but should not dominate the view, and scenic quality should be partially retained. Water quality and quantity is fair and supports the corridor's outstandingly remarkable value of fisheries.

The river is accessible from Douglas County Road No. 37 and Smith River Road (BLM road No. 21-7-27.0). These roads parallel the river for the entire length of the study segment and cross the river at two separate locations. The roads are primarily used for logging and recreational activities. Traffic can be heard from most portions of the river and the road is noticeable from the river throughout most of the study segment.

Smith River Potential Classification Summary

Activity	Wild	Scenic	Recreational
Water resources development	M[1]	M	M
Shoreline development	DM[2]	DM	M
Water quality	M	M	M
Accessibility	DM	DM	M

[1]M: Meets
[2]DM: Does not meet

III. Suitability Factors

A. Current Land Status and Use

1. Land Ownership

The Roseburg BLM district administers 9.6 stream miles which is 55percent of the river segment. Land ownership status within the study segment is shown below.

2. Land Use

The main land use within the study segment is general forestry operations. On the private land within the corridor most of the original forest land has been harvested within the last 25 years. These lands are now young conifer plantations. There has been timber harvesting on the O&C lands within the corridor. A minor amount of livestock grazing and agricultural activities occur within the corridor.

Historically, there has been minor residential development within the corridor. Douglas County has zoned the river corridor as timberlands, which restricts further subdivision of the private land for other than forest management activities and prevents residential development.

Smith River Segment Ownership and Status Within the River Corridor

Ownership	Land Base Acres	Percent Ownership
BLM		
Public Domain	0	
O&C Lands	2,312	55
Forest Service	0	
State	0	
County	0	
Aaron U. Jones	1,484	36
International Paper	327	8
Private Individuals	38	1
Total	**4,161**	**100**

Forestry practices on private land within the corridor are regulated by the State of Oregon under the Forest Practices Act.

As of May 15, 1991, there is one existing placer mining claim located within the corridor. No federal mineral leases are in effect. The study area is open to competitive lease for oil and gas. The area is withdrawn from water power designation and power site reserves. No existing or proposed power line corridors were identified in the 1991 Western Regional Corridor study.

B. Reasonable Foreseeable Uses of the Land and Water Which May be Affected by Designation.

1. Recreation

Designation of Smith River as a Wild and Scenic River may draw additional people to this drainage. However, recreational opportunities are limited. Swimming in Smith River is not a high use recreation activity now, and it is not likely that a drastic increase in this use would occur. Increased visitor use of the Smith River drainage could necessitate additional facility development in the future (ie. restroom facilities, off-road parking, day use area and interpretive facilities) to accommodate this increase of visitor use.

2. Timber

The recreational classification would not restrict timber harvest on federal land within the study segment beyond the restrictions proposed in the Resource Management Plan. Designation would not further restrict the timber harvest on the private lands within the study segment.

3. Mining

The Geology of the area indicates a very low potential for locatable mineral deposits and there is no historic record of any past or current mineral activity in the study segment. Section 9 (b) of the Wild and Scenic Rivers Act states that only lands within the boundary designated "wild" are withdrawn from mineral entry. Designation as "recreational" would have no effect toward enhancing, foreclosing, or curtailing mineral activity.

4. Hydroelectric

Based on data from Oregon State University's Water Resources Research Institute's (WRRI) 1979 study, "A Resource Survey of River Energy and Low-Head Hydroelectric Power Potential in Oregon" hydroelectric power potential for this segment of Smith River would be:

$$P = (0.08475)\,(Q)\,(H)\,(1.0) = 2400 \text{ kilowatts}$$

P = power (kilowatts)

Q = streamflow (cuft/sec)

H = head (feet)

This value is based on assumption of complete utilization of the entire river reach, use of all the water available, and 100 percent operating efficiency of the hydroelectric plant. The WRRI study also identifies "special fish problems" as a feasibility restraint on this segment.

There are no Federal Energy Regulatory Commission (FERC) applications for irrigation, or proposals for dams or diversions on file for this river segment. This segment has been identified by the Northwest Power Planning Council (NPPC) as a "protected area" for hydroelectric development.

Designation of the segment would restrict FERC from licensing construction of new federally built, permitted, or licensed dams plus other resource projects which would have a direct adverse effect on the free flowing values of the stream. However Section 10 (a) of the Federal Powers Act requires FERC to consider consistency with federal or state comprehensive plans for improving, developing or constructing a waterway prior to issuing licenses. Licensing by FERC is restricted because of inconsistency with the NPPC "protected area" designation. Designation would give congressional protection from hydroelectric development of the study segment, however development is essential foreclosed already under current regulations.

5. Wildlife

The study segment provides a variety of habitat types along Smith River, as a result animal life in the segment is fairly diverse.

Several of the species that may occur in the suitable habitat in the study segment are considered as sensitive by the State Department of Fish and Wildlife and are included on their critical species list, or are listed as federal threatened, or as candidates by the Federal Government. These are: Northern Spotted Owl, Mountain Quail, Northern Goshawk, Pileated Woodpecker, White-Footed Vole, Townsend's Big Eared Bat, Marbled Murrelet, Northwestern Pond Turtle, Foothills Yellow-Legged Frog, Northern Red-legged Frog, and Clouded Salamander.

Designation of the segment as recreational under the Wild and Scenic Rivers Act would have little effect on the consideration given for wildlife utilizing habitat in the study segment. Species listed under federal law would be managed according to the Endangered Species Act, which is more stringent than the Wild and Scenic Rivers Act. Species listed by the State of Oregon would be protected under bureau policy regulating activities that affect those species on bureau lands. Designation would not preclude forest management activities addressed in the proposed Resource Management Plan.

6. Fisheries

Smith River serves as spawning and rearing habitat for several anadromous and resident fish. None of the fish species inhabiting Smith River have been classified as threatened or endangered, however populations of wild coho salmon and searun cutthroat trout are depressed and may be declining. Coho salmon, winter steelhead, and searun cutthroat trout are the anadromous salmonid species which utilize the stream during part of their life cycle. Resident trout using the river include cutthroat, rainbow, brook, and brown trout. Additional species include suckers, dace, and redside shiners. Effects of designation on fisheries is discussed in more detail in the next section "Effects on the Outstandingly Remarkable Values".

7. Private Lands

The private lands within the study segment would not be affected by designation. Since the federal land ownership within the study segment exceeds 50 percent of the land base land acquisition of private lands by condemnation would be prohibited. Land acquisition and easements could be acquired from willing landowners. The private lands are zoned timberlands which restricts further subdivision.

D. Effects on Outstandingly Remarkable Values

The fisheries values currently within the study segment are primarily a reflection of the total watershed condition within the Smith River Basin. Stream conditions have been determined by events and actions which have taken place in the upper reaches of the watershed. The one-half mile corridor contributes only a small amount towards the stream conditions which support the fisheries values that are found within the stream study segment. The main road paralleling the river in this stretch impacts fishery habitat with increased sedimentation and a loss of riparian vegetation. The road and the associated impacts would not change if the study segment were designated.

Current management practices on Bureau lands attempt to minimize downstream impacts to fisheries values within the stream system. Instream projects have also been undertaken to mitigate, restore, or enhance favorable conditions for fisheries within the main stem and tributaries of the Smith River system.

If the study segment is designated under the Wild & Scenic Rivers Act little, if any, of the current land management practices now in place would change. Designation would only apply to the study segment along Smith River and would not consider the areas of principal importance outside the half mile corridor. Designation would preclude hydroelectric development but would allow mining, timber harvest and recreational use to continue essentially at present levels. The benefit to the ORV, fisheries, would be negligible.

E. How the River Segment Would Be Managed if it Were Not Designated

If the river were not added to the National Wild and Scenic Rivers System, the BLM would continue to manage the land under its jurisdiction within the study segment with continuing emphasis on protection of the riparian values. The ORV of fisheries would be protected by such management.

Special consideration will be given to the management of riparian zones and water quality in all drainages of the Roseburg District under the Preferred Alternative of the Resource Management Plan. Protection of Riparian Management Areas (RMA) will be attained by buffers of varying width depending upon the order of the stream. Third, fourth, fifth, and sixth order and greater streams will receive buffers of 105, 150, 210, and 240 feet on either side of the stream. This translates to approximately 25.5 acres/mile for third order streams. For 4th, 5th, and 6th order streams, the equivalent acres per mile are 36.4, 50.9 and 58.2.

The study segment of Smith River is a seventh order stream and would receive a buffer of 240 feet on both sides of the river. In addition, all first and second order perennial water in the drainage would be protected through creation of riparian management areas with an average width of 75 feet on each side of the stream with a minimum width of 50 feet as proposed in the Resource Management Plan.

The entire length of the study segment along Smith River will be managed as an Old-Growth Ecosystem Area (OGEA) under the preferred alternative of the RMP. This area will be managed with a harvest rotation age of 300 years. Under the preferred Alternative, harvest activity in the OGEA would be deferred for the first eight decades. Eighty percent of the lands controlled by the BLM in this OGEA would retain old-growth characteristics.

The BLM will continue to work cooperatively with other agencies including the Oregon Department of Fish and Wildlife and private land owners to enhance the fisheries ORV in Smith River and to provide sound riparian management on all lands along the stream reach.

The Resource Management Plan identifies the Smith River drainage as an "avoidance area" restricting rights-of-way grants for hydro power development in the area.

F. Cost of Administration

An estimated cost of $300,000 would be associated with the designation of Smith River as a Wild and Scenic River. There would be two types of costs involved: 1) start up, non reoccurring cost; and 2) annual maintenance costs which could be expected year after year. Start up costs are estimated at $280,000 and would involve the following items: 1) Development of the River Management Plan, 2) New facility development, 3) Water monitoring analysis, 4) Land acquisition, 5) Fish enhancement project work, and 5) Boundary survey and posting. The recurring annual costs are estimated to be $19,000 and these costs would be associated with : 1) Law enforcement, 2) Facility maintenance, 3) ongoing water monitoring and 4) fish habitat structure maintenance. If the decision were made to acquire private lands from willing sellers by purchase rather than exchange this cost could double.

G. Administering Agency

If Smith River were added to the National Wild and Scenic Rivers System, the BLM would continue to manage the land and resources it currently administers.

IV. Finding and Rationale

A. Finding

The 17.5 mile segment of Smith River from the confluence with the South Fork of Smith River to the western boundary of the resource area was found to be unsuitable for designation as a recreational river under the National Wild and Scenic Rivers Act.

The BLM'S intent in the preferred alternative of the Draft RMP/EIS to protect the ORV on BLM-administered land indicate that designation will not be needed to protect this value. Current and proposed land management activities continue to recognize the value of Smith River fisheries and will be applied across the watershed, not just the main stem as would be designated under the Wild and Scenic Rivers Act. The ORV is not threatened by dam construction or irrigation development. On Private land, the Oregon Forest Practices Act is designed to protect the fisheries from impacts associated with timber management activities.

Most parties are in favor of protection of the fisheries ORV. Considering all the factors, BLM believes the river segment's ORV can best be protected by a combination of actions set forth in the preferred alternative of this Draft RMP/EIS and by the management of private land consistent with county zoning and state law.

Canton Creek

I. Summary

The 10.7 mile segment of Canton Creek from the USFS boundary upstream to Tin Cup Creek was studied to determine suitability for designation as a recreational river under the National Wild and Scenic Rivers Act.

II. Background

A. Description of the Stream

Canton Creek is part of the Steamboat drainage which is a principal tributary of the North Umpqua River. The Roseburg District Office identified as eligible a 10.7 mile segment of Canton Creek from the U.S. Forest Service boundary between sections 31 and 36, T.25 S., R.1 E. and R.1 W. W.M. to the confluence with Tin Cup Creek in section 24, T.24 S., R.1 W. W.M.

Canton Creek provides important spawning and rearing habitat for anadromous fish species and is managed primarily for that purpose. The stream has been closed to all angling since 1932, by the State of Oregon, to protect fisheries values.

There is one low standard campground within the segment, no trails for hiking and water sport recreation is not practicable due to the stream morphology and limited flows. The main recreational use of this stream is swimming, however this use is relatively minor. Access to the stream for recreational use is limited due to the steep banks and thick vegetation.

Portions of the study segment, a one-half mile corridor (one-quarter mile on each side of the stream), have been clearcut while other parts have old-growth coniferous forests. An asphalt BLM road parallels the creek the entire length of the study area.

Prior to 1970 management on public and private lands as well as natural events contributed to the historical condition of Canton Creek and resulted in degradation of fisheries habitat. However, changes in land management practices and forest practice laws have resulted in the recovery of stream side management areas improving water quality. S. W. Hostetler 1991 study, "Analysis and modeling of long-term stream temperatures on the Steamboat Creek Basin, Oregon: implications for land use and fish habitat" indicates a downward trend in summer stream temperatures in Canton Creek. Steve Holaday's graduate work further collaborates this trend and his data demonstrates that stream temperatures are cooling as a reflection of recovery by riparian habitat vegetation in Canton Creek.

B. Eligibility Determination

The legislative history of the Omnibus Oregon Wild and Scenic Rivers Act of 1988 added Steamboat Creek "to the amendment as a study river to determine whether wild and scenic designation would offer management tools to better protect (the fisheries) value." In addition the committee directed the "Bureau of Land Management to extend fishery management emphasis to the tributaries of Steamboat Creek, including Canton Creek, to optimize fish production, and including where necessary, increased law enforcement activities."

Canton Creek is free-flowing within the 10.7 mile study segment. Resident and anadromous fish are the single outstandingly remarkable value (ORV) identified through eligibility assessment. This segment supports several native stocks of different species of fish including; coho and spring chinook salmon, winter and summer steelhead, resident and sea run cutthroat trout. The production of steelhead from this segment is approximately 21 percent of the total produced in the North Umpqua Basin. The North Umpqua River is noted for being one of the top summer steelhead fisheries in the Northwest.

This suitability assessment was prepared based on these findings and BLM's sixty-five percent administrative jurisdiction along the one-half mile stream corridor.

C. Classification Determination.

The stream's highest potential classification is recreational as shown below. The stream is free of any impoundments or diversions, however minor stream-bank modification has occurred from riprap placement and construction of bridge abutments. Past logging activity is visible from the stream and access road throughout most of the segment. The Scenic Quality Class is C (low), sensitivity is low, and Management Class is IV (modification) due to extensive modification of the landscape, based on the district VRM inventory.

Water quality and quantity is not limiting to the corridor's outstandingly remarkable value of fisheries. Additionally water temperature as shown by both Hostetler and Holaday is improving.

The stream is accessible from BLM Road No. 25-1E-31.0 Canton Creek Road and BLM road No. 24-1-26.0 Upper Canton Creek Road. These roads parallel the creek for the entire length of the study segment and cross the stream at four separate locations. The roads are primarily used for logging and recreational activities. Traffic can be heard from most portions of the stream and the road is noticeable from the creek throughout most of the study segment.

Canton Creek Potential Classification Summary

Activity	Wild	Scenic	Recreational
Water resources development	M[1]	M	M
Shoreline development	DM[2]	DM	M
Water quality	M	M	M
Accessibility	DM	DM	M

[1]M: Meets
[2]DM: Does not meet

III. Suitability Factors

A. Current Land Status and Use

1. Land Ownership

The Roseburg BLM district administers 6.8 stream miles which is 64percent of the stream segment. Land ownership status within the study segment is shown below.

2. Land Use

The main land use within the study segment is general forestry operations. On the private land within the corridor most of the original forest land has been harvested within the last 25 years. These lands are now young conifer plantations. There has been timber harvesting on some of the O&C lands within the corridor. No Livestock grazing or agricultural activities occur within the corridor.

There has been no residential development within the corridor. Douglas County has zoned the stream corridor as timberlands, which restricts further subdivision of the private land for other than forest management activities and prevents residential development. Forestry practices on private land are regulated by the State of Oregon under the Forest Practices Act.

There are no known mining claims located within the corridor and no federal mineral leases are in effect. There are no utility rights-of-way within or crossing the corridor. A power line right-of-way is located near the study segment along the southern boundary.

For a description of recreation use refer to the Background section of this report.

Canton Creek Segment Ownership and Status Within the Stream Corridor

Ownership	Land Base Acres	Percent Ownership
BLM		
Public Domain	0	
O&C Lands	2204	65
Forest Service	0	
State	0	
County	0	
Champion Internal Corp.	862	25
Menasha	131	4
Roseburg Resources	210	6
Private Individuals	0	
Total	**3407**	**100**

B. Reasonable Foreseeable Uses of the Land and Water Which May be Affected by Designation.

1. Recreation

Designation of Canton Creek as a Wild and Scenic River would very likely draw additional people to this drainage. However, recreational opportunities are limited. The existing campground would probably get additional use, and some additional associated swimming in the creek could be expected. However, since swimming in Canton Creek is not a high use recreation activity now, it's not likely that a drastic increase in this use would occur. Fishing in Canton Creek has been prohibited since 1932, and this restriction is not likely to change with designation. Increased visitor use of the Canton Creek drainage could necessitate additional facility development in the future (ie. restroom facilities, off-road parking, day use area and interpretive facilities) to accommodate this increase of visitor use. Accommodation or regulation of this increase use could also occur administratively by discouragement, elimination, or closure of areas. At present, no additional recreation facilities are planned in the drainage.

2. Timber

The recreational classification would not restrict timber harvest on federal land within the study segment beyond the restrictions proposed in this Resource Management Plan. Designation would not further restrict the timber harvest on the private lands within the study segment.

3. Mining

   The Geology of the area indicates a very low potential for exploitable mineral deposits and there is no record of any past or current mineral activity in the study segment. Section 9 (b) of the Wild and Scenic Rivers Act states that only lands within the boundary designated "wild" are withdrawn from mineral entry. Designation as "recreational" would have no effect toward enhancing, foreclosing, or curtailing mineral activity.

4. Hydroelectric

   Based on data from Oregon State University's Water Resources Research Institute's (WRRI) 1979 study, "A Resource Survey of River Energy and Low-Head Hydroelectric Power Potential in Oregon" hydroelectric power potential for this segment of Canton Creek would be:

   P = (0.08475) (Q) (H) (1.0) = 3800 kilowatts

   P = power (kilowatts)

   Q = streamflow (cuft/sec)

   H = head (feet)

   This value is based on assumption of complete utilization of the entire stream reach, use of all the water available, and 100 percent operating efficiency of the hydroelectric plant. The WRRI study also identifies two feasibility restraints on this segment "land use restrictions" and "special fish problems".

   There are no Federal Energy Regulatory Commission (FERC) applications for irrigation, or proposals for dams or diversions on file for this stream segment. This segment has been identified by the Northwest Power Planning Council (NPPC) as a "protected area" for hydroelectric development because of fisheries habitat.

   Designation of the segment would restrict FERC from licensing construction of new federally built, permitted, or licensed dams plus other resource projects which would have a direct adverse effect on the free flowing values of the stream. However Section 10 (a) of the Federal Powers Act requires FERC to consider consistency with federal or state comprehensive plans for improving, developing or constructing a waterway prior to issuing licenses. Licensing by FERC is restricted because of inconsistency with the NPPC "protected area" designation. Designation would give congressional protection from hydroelectric development of the study segment, however development is essentially foreclosed under current regulations.

5. Wildlife

   The study segment provides a variety of habitat types along Canton Creek and as a result animal life in the segment is fairly diverse.

   Several of the species found in the study segment are considered sensitive by the State Department of Fish and Wildlife and are included on their critical species list, or are listed as federal threatened, or as candidates by the federal government. These are: Northern spotted owl, mountain quail, northern goshawk, pileated woodpecker, ringtail, California mountain kingsnake, northern red-legged frog, and clouded salamander. All of these species have been noted in the study segment. Designation of the segment as recreational under the Wild and Scenic Rivers Act would have little effect on the consideration given for wildlife utilizing habitat in the study segment. Species listed under federal law would be managed according to the Endangered Species Act, which is more stringent than the Wild and Scenic Rivers Act. Species listed by the State of Oregon would be protected under bureau policy regulating activities that affect those species on bureau lands. Designation would not preclude those forest management activities addressed in the proposed Resource Management Plan.

6. Fisheries

   Canton Creek serves as spawning and rearing habitat for several anadromous and resident fish. None of the fish species inhabiting Canton Creek have been classified as threatened or endangered, however populations of wild coho and sea run cutthroat trout are depressed and may be declining. Coho salmon, winter and summer steelhead, and sea run cutthroat are the anadromous salmonid species

which utilize the stream during part of their life cycle. Resident trout using the stream include cutthroat, rainbow, brook, and brown trout. Additional species include sculping, suckers, dace, and redside shiners. Affects of designation on fisheries is discussed in more detail in the next section "Effects on the Outstandingly Remarkable Values".

7. Private Lands

The private lands within the study segment would not be affected by designation. Since the federal land ownership within the study segment exceeds 50 percent of the land base land acquisition of private lands by condemnation would be prohibited. Land acquisition and easements could be acquired from willing landowners. The private lands are zoned timberlands which restricts further subdivision.

D. Effects on Outstandingly Remarkable Values

The fisheries values currently within the study segment are primarily a reflection of the total watershed condition within the Canton Creek Basin. Stream conditions have been determined by events and actions which have taken place in the upper reaches of the watershed. The one half mile corridor contributes only a small amount towards the stream conditions which support the fisheries values that are found within the stream study segment.

The value of contributing watersheds on fisheries has long been recognized in the Canton Creek drainage. Management practices on Bureau lands attempt to minimize downstream impacts to fisheries values within the stream system. Instream projects have also been undertaken to mitigate, restore, or enhance favorable conditions for fisheries within the mainstem and upper reaches of the Canton Creek system.

If the study segment is designated under the Wild & Scenic Rivers Act little, if any, of the current land management practices now in place would change. Designation would only apply to the study segment along Lower Canton Creek and would not consider the areas of principal importance outside the half mile corridor. Designation would preclude hydroelectric development but would allow mining, timber harvest,and recreational use to continue essentially at present levels. The benefit to the ORV, fisheries, would be negligible.

E. How the Stream Segment Would Be Managed if it Were Not Designated

If the stream were not added to the National Wild and Scenic Rivers System, the BLM would continue to manage the land under its jurisdiction within the study segment with continuing emphasis on protection of the riparian values. The ORV of fisheries would be protected by such management.

Special consideration will be given to the management of riparian zones and water quality in all drainage of the Roseburg District under the Preferred Alternative of the Resource Management Plan. Protection of Riparian Management Areas (RMA) will be attained by leaving uncut buffers of varying width depending on the order of the stream. All fish bearing streams will receive buffers of 150 feet minimum either side of the stream. Average buffer widths of 75 feet (50 ft. minimum) would be established for all first and second order perennial streams. Third, fourth, fifth, and sixth order and greater streams will receive buffer widths of 105, 150, 210, and 240 feet respectively on either side of the stream. The study segment of Canton Creek is fifth and sixth order and would receive a buffer of 240 feet from the U.S. Forest Service boundary north to Pass Creek and a buffer of 210 from Pass Creek to Tin Cup Creek.

The upper portion of Canton Creek (approximately 6.7 miles of the study segment) will be managed as an Old-Growth Ecosystem Area (OGEA) under the preferred alternative of the RMP. This area will be managed with a rotation age of 300 years. Eighty percent of the lands controlled by BLM in this OGEA would retain old-growth characteristics. This area would be deferred from any planned harvest of old-growth for eighty years.

The lower portion of Canton Creek (approximately 4.0 miles of the study segment) will be managed as a Connectivity Area (CA) under the preferred alternative of the RMP. This area will be managed with a rotation age of 125 years. Timber harvest activity would retain 12-16 trees per acre with a management emphasis to regain old-growth characteristics on these lands.

The BLM will continue to work cooperatively with other agencies including the Oregon Dept. of Fish and Wildlife and private land owners to enhance the fisheries ORV in Canton Creek and to provide sound riparian management on all lands along the stream reach. Additionally an attempt would be made to acquire lands from private landowners to maximize BLM ownership in Canton Creek.

The Resource Management Plan also identifies the Canton Creek drainage as an "avoidance area" restricting rights-of-way grants for hydro power development in the area.

Also, no additional recreational facilities are proposed in the drainage. Law enforcement has already been increased via the hiring of a BLM ranger in 1991.

F. Cost of Administration

An estimated cost of $330,000 would be associated with the designation of Canton Creek as a Wild and Scenic River. There would be two types of costs involved: 1) start up, non reoccurring cost; and 2) annual maintenance costs which could be expected year after year. Start up costs are estimated at $300,000 and would involve the following items: 1) Development of the River Management Plan, 2) New facility development, 3) Water monitoring analysis, 4) Land acquisition, 5) Fish enhancement project work, and 5) Boundary survey and posting. The recurring annual costs are estimated to be $30,000 and these costs would be associated with: 1) Law enforcement, 2) Facility maintenance, 4)ongoing water monitoring, 5) and fish habitat structure maintenance. If the decision were made to acquire private lands from willing sellers by purchase rather than exchange this cost could double.

G. Administering Agency

If Canton Creek were added to the National Wild and Scenic Rivers System, the BLM would continue to manage the land and resources it currently administers.

IV. Finding and Rationale

A. Finding

The 10.7 mile segment of Canton Creek from the USFS boundary upstream to Tin Cup Creek was found to be unsuitable for designation as a recreational river under the National Wild and Scenic Rivers Act.

The BLM'S intent in the preferred alternative of this Draft RMP/EIS to protect the ORV on BLM-administered land indicate that designation will not be needed to protect this value. Current and proposed land management activities continue to recognize the value of Canton Creek fisheries and will be applied across the watershed, not just the mainstem as would be designated under the Wild and Scenic Rivers Act. The ORV is not threatened by dam construction or irrigation development. On Private land the requirements of the Oregon Forest Practices Act should protect the fisheries from impacts of timber management.

Public opinion for designation is split, however most parties are in favor of protection of the fisheries ORV. Considering all the factors, BLM believes the stream segment's ORV can best be protected by a combination of actions set forth in the preferred alternative of this Draft RMP/EIS, though cooperative agreements, and by the management of private land consistent with county zoning and state law.

Appendix 2-11
Timber Harvest and Management Details, Preferred Alternative

Table 2-11-1. Preferred Alternative Planned Harvest by Sustained Yield Unit (MMCF and MMBF harvest estimates per decade)*

	Decade									
	1st		2nd		3rd		5th		10th	
Sustained Yield Unit	MMCF	MMBF	MMCF	MMBF	MMCF	MMBF	MMCF	MMBF	MMCF	MMBF
South Umpqua	45	278	45	274	45	269	45	253	45	271
Douglas	118	768	118	769	118	735	118	645	118	726
District Total	**163**	**1,046**	**163**	**1,044**	**163**	**1,004**	**163**	**898**	**163**	**997**

*Estimates summarized from TRIM-Plus Harvest files may differ slightly from Ten-Year Scenario derives statistics.

Table 2-11-2. Expected Preferred Alternative Harvest by Allocation and Management Stage (average acres and mmcf per decade)*

	Decade														
	1st			2nd			3rd			5th			10th		
	Acres	MMCF	MMBF	Acres	MMCF	MMBF	Acres	MMCF	MMBF	Acres	MMCF	MMBF	Acres	MMCF	MMBF
Old Growth Emphasis Acres															
Regeneration Harvest	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	5,115	28.20	183.97
Density Management	593	1.53	7.73	16,796	11.58	70.75	6,599	19.39	97.03	19,096	47.70	254.41	130	0.46	2.73
Connectivity Areas															
Regeneration Harvest	10,741	43.22	280.78	8,909	43.28	280.36	7,354	38.91	249.42	5,345	27.08	151.68	846	9	55
Density Management	104	0.31	1.57	427	1.34	6.72	2,504	7.71	38.59	3,759	9.58	51.59	1,317	4	20
Timber Mangement Emphasis Areas															
Regeneration Harvest	22,674	116,58	748.66	19,035	104.31	672.36	14,778	93.78	601.16	7,832	65.32	369.84	8,134	109	667
Density Management	640	1.32	7.24	1,204	2.46	13.49	1,493	3.18	17.80	5,496	13.28	70.85	4,857	13	68
Totals															
Regeneration Harvest	**33,415**	**160**	**1,029**	**27,944**	**148**	**953**	**22,132**	**133**	**851**	**13,177**	**92**	**522**	**14,095**	**146**	**906**
CT & Density Management	**1,377**	**3**	**17**	**18,427**	**15**	**91**	**10,596**	**30**	**153**	**28,351**	**71**	**377**	**6,304**	**17**	**91**
Combined Harvest Activities	**34,752.00**	**162.97**	**1045.98**	**46,371.00**	**162.97**	**1,043.68**	**32,728.00**	**162.97**	**1,003.99**	**41,528.00**	**162.97**	**898.37**	**20,399.00**	**162.97**	**996.93**

*Acreage and volume estimates summarized from TRIM-Plus Inventory and Harvest files.
First decade estimates may differ slightly from other Preferred Alternate statistics derived from the Ten-Year Scenario process.

Table 2-11-3. Preferred Alternative Assumed Average Annual Stand Treatments by Decade (Acres)

Treatment	Decade 1st	2nd	3rd	5th	10th
Plant Genet. Selected Stock	29,000	30,200	23,900	14,200	15,200
Competing Vegetation Control	24,000	19,600	15,500	9,200	9,900
Precommercial Thin (PCT)	49,600	27,200	22,700	14,500	11,800
Fertilization	58,200	39,700	77,200	88,500	15,800

Appendix 2-12
Proposed Road Closures by Alternative

Road #	# Miles	Alternatives Total Acres NA	A	B	C	D	E	PA
26-7-8.0	1.5	N	N	N	Y	Y	Y	Y
26-7-8.1	1.2	N	N	N	Y	Y	Y	Y
26-7-17.0	0.2	N	N	N	Y	Y	Y	Y
24-8-10.1	1.6	N	N	N	Y	Y	Y	Y
24-8-10.3	0.7	N	N	N	Y	Y	Y	Y
24-8-21.3	3.0	N	N	N	Y	Y	Y	Y
24-8-28.2	0.3	N	N	N	Y	Y	Y	Y
24-8-29.0	0.4	N	N	N	Y	Y	Y	Y
24-8-21.2	0.5	N	N	N	Y	Y	Y	Y
24-8-28.0	0.3	N	N	N	Y	Y	Y	Y
24-8-26.4	0.5	N	N	N	Y	Y	Y	Y
24-8-27.3	1.3	N	N	N	Y	Y	Y	Y
24-8-34.0	0.6	N	N	N	Y	Y	Y	Y
25-3-19.0	1.5	N	N	N	Y	N	N	Y
25-8-4.0	0.5	N	N	Y	Y	Y	Y	Y
25-8-3.0	0.4	N	N	Y	Y	Y	Y	Y
25-8-9.1	0.4	N	N	N	Y	Y	Y	Y
25-8-1.1	0.5	N	N	N	Y	Y	Y	Y
25-8-13.0	1.2	N	N	N	Y	Y	Y	Y
25-7-21.0	1.6	N	N	Y	Y	Y	Y	Y
25-7-18.0	1.1	N	N	N	Y	Y	Y	Y
24-8-34.1	0.6	N	N	N	Y	Y	Y	Y
31-6-10.2	0.3	N	N	N	Y	Y	Y	Y
31-6-10.1	1.0	N	N	N	Y	Y	Y	Y
31-6-3.0	1.5	N	N	N	Y	Y	Y	Y
31-6-3.1	0.5	N	N	N	Y	Y	Y	Y
31-6-3.2	0.6	N	N	N	Y	Y	Y	Y
31-6-3.0	0.3	N	N	N	Y	Y	Y	Y
31-6-2.1	0.7	N	N	N	Y	Y	Y	Y
31-6-2.0	2.0	N	N	N	Y	Y	Y	Y
31-5-16.0	0.5	N	N	N	Y	Y	Y	Y
31-5-5.0	0.5	N	N	N	Y	Y	Y	Y
31-5-10.2	1.4	N	N	N	Y	Y	Y	Y

Table 2-12 (cont.)

Road #	# Miles	Alternatives Total Acres						
		NA	A	B	C	D	E	PA
31-4-7.0	1.0	N	N	N	Y	Y	Y	Y
31-5-13.1	2.7	N	N	N	Y	Y	Y	Y
31-4-19.0	0.7	N	N	N	Y	Y	Y	Y
31-4-11.0	0.7	N	N	N	Y	Y	Y	Y
31-4-15.0	2.0	N	N	N	Y	Y	Y	Y
31-4-1.1	0.6	N	N	N	Y	Y	Y	Y
31-4-1.2	0.6	N	N	N	Y	Y	Y	Y
31-3-17.1	1.3	N	N	N	Y	Y	Y	Y
31-3-17.0	0.4	N	N	N	Y	Y	Y	Y
31-3-21.0	0.4	N	N	N	Y	Y	Y	Y
31-3-16.1	1.0	N	N	N	Y	Y	Y	Y
31-3-33.0	0.5	N	N	N	Y	Y	Y	Y
31-3-27.1	0.2	N	N	N	Y	Y	Y	Y
31-3-10.1	0.2	N	N	N	Y	Y	Y	Y
31-3-10.3	0.4	N	N	N	Y	Y	Y	Y
31-3-10.5	0.7	N	N	N	Y	Y	Y	Y
31-3-2.4	0.5	N	N	N	Y	Y	Y	Y
31-3-2.3	0.6	N	N	N	Y	Y	Y	Y
31-3-1.0	2.0	N	N	N	Y	Y	Y	Y
31-3-1.1	0.5	N	N	N	Y	Y	Y	Y
31-3-1.2	0.2	N	N	N	Y	Y	Y	Y
31-3-2.2	1.1	N	N	N	Y	Y	Y	Y
31-3-1.3	1.2	N	N	N	Y	Y	Y	Y
31-3-1.4	1.0	N	N	N	Y	Y	Y	Y
31-3-1.5	1.0	N	N	N	Y	Y	Y	Y
30-2-31.0	0.5	N	N	N	Y	Y	Y	Y
30-3-23.5	0.2	N	N	N	Y	Y	Y	Y
30-3-13.3	1.0	N	N	N	Y	Y	Y	Y
30-3-13.1	0.7	N	N	N	Y	Y	Y	Y
30-3-13.4	0.4	N	N	N	Y	Y	Y	Y
30-3-22.0	0.7	N	N	N	Y	Y	Y	Y
30-3-1.0	0.8	N	N	N	Y	Y	Y	Y
30-3-13.1	1.0	N	N	N	Y	Y	Y	Y
29-2-32.4	0.5	N	N	N	Y	Y	Y	Y
29-2-33.0	1.1	N.	N	Y	Y	Y		
29-2-34.0	0.5	N	N	N	Y	Y	Y	Y
29-2-27.0	0.7	N	N	N	Y	Y	Y	Y
29-2-9.1	1.0	N	N	N	Y	Y	Y	Y

Table 2-12 (cont.)

Road #	# Miles	Alternatives Total Acres NA	A	B	C	D	E	PA
28-2-32.2	0.4	N	N	N	Y	Y	Y	Y
28-2-32 (Quarry rd.)	0.2	N	N	N	Y	Y	Y	Y
24-2-11.4	0.7	N	N	N	Y	Y	Y	Y
24-2-11.3	0.3	N	N	N	Y	Y	Y	Y
24-2-11.1	0.5	N	N	N	Y	Y	Y	Y
24-2-3.0	0.3	N	N	N	Y	Y	Y	Y
24-2-24.0	2.0	N	N	N	Y	Y	Y	Y
24-2-3.1	0.3	N	N	N	Y	Y	Y	Y
24-2-3.2	0.2	N	N	N	Y	Y	Y	Y
24-2-4.0	0.6	N	N	N	Y	Y	Y	Y
24-2-3.4	0.2	N	N	N	Y	Y	Y	Y
24-2-25.0	1.2	N	N	N	Y	Y	Y	Y
24-1-23.1	0.3	N	N	N	Y	Y	Y	Y
24-1-22.1	1.2	N	N	N	Y	Y	Y	Y
24-1-35.2	0.8	N	N	N	Y	Y	Y	Y
24-1-35.3	0.4	N	N	N	Y	Y	Y	Y
24-1-33.1	0.2	N	N	N	Y	Y	Y	Y
24-1-32.3	0.5	N	N	N	Y	Y	Y	Y
25-1.4.5	0.4	N	N	N	Y	Y	Y	Y
25-2-28.1	0.7	N	N	N	Y	Y	Y	Y
25-2-21.1	0.3	N	N	N	Y	Y	Y	Y
25-2-17.0	0.3	N	N	N	Y	Y	Y	Y
25-2-17.4	0.3	N	N	N	Y	Y	Y	Y
25-2-17.1	0.1	N	N	N	Y	Y	Y	Y
25-2-17.2	0.3	N	N	N	Y	Y	Y	Y
25-2-5.2	0.2	N	N	N	Y	Y	Y	Y
25-2-8.1	0.6	N	N	N	Y	Y	Y	Y
25-2-5.0	0.4	N	N	N	Y	Y	Y	Y
25-2-1.1	0.5	N	N	N	Y	Y	Y	Y
25-2-1.3	0.5	N	N	N	Y	Y	Y	Y
25-2-1.6	0.1	N	N	N	Y	Y	Y	Y
25-2-1.2	0.6	N	N	N	Y	Y	Y	Y
25-2-3.1	0.7	N	N	N	Y	Y	Y	Y
25-2-3.2	0.3	N	N	N	Y	Y	Y	Y
25-2-1.1	0.3	N	N	N	Y	Y	Y	Y
25-2-1.0	0.3	N	N	N	Y	Y	Y	Y
25-2-1.4	0.3	N	N	N	Y	Y	Y	Y

Table 2-12 (cont.)

Road #	# Miles	Alternatives Total Acres NA	A	B	C	D	E	PA
25-1-7.1	0.6	N	N	N	Y	Y	Y	Y
25-1-11.1	0.6	N	N	N	Y	Y	Y	Y
25-1-11.2	0.3	N	N	N	Y	Y	Y	Y
25-1-2.5	1.0	N	N	N	Y	Y	Y	Y
25-1-22.1	1.3	N	N	N	Y	Y	Y	Y
25-1-25.1	0.5	N	N	N	Y	Y	Y	Y
25-1-25.2	0.3	N	N	N	Y	Y	Y	Y
25-1-24.2	0.4	N	N	N	Y	Y	Y	Y
25-1-24.1	0.7	N	N	N	Y	Y	Y	Y
25-1-7.8	0.7	N	N	N	Y	Y	Y	Y
25-1-7.9	0.3	N	N	N	Y	Y	Y	Y
25-1-7.5	0.4	N	N	N	Y	Y	Y	Y
25-1-7.7	0.4	N	N	N	Y	Y	Y	Y
26-2-9.0	0.3	N	N	N	Y	Y	Y	Y
26-2-17.0	1.3	N	N	N	Y	Y	Y	Y
26-2-20.0	0.5	N	N	N	Y	Y	Y	Y
26-2-31.0	0.7	N	N	N	Y	Y	Y	Y
27-2-5.1	0.6	N	N	N	Y	Y	Y	Y
27-2-11.5	1.0	N	N	N	Y	Y	Y	Y
27-2-17.2	0.3	N	N	N	Y	Y	Y	Y
27-2-16.1	0.3	N	N	N	Y	Y	Y	Y
27-2-21.2	0.3	N	N	N	Y	Y	Y	Y
27-2-21.4	0.2	N	N	N	Y	Y	Y	Y
27-2-21.3	0.3	N	N	N	Y	Y	Y	Y
	129.9 Miles	19,500 Ac.						

Table 2-12 (cont.)

Road #	# Miles	Alternatives Total Acres						
		NA	A	B	C	D	E	PA
25-7-10.1	1.8	N	N	Y	Y	Y	Y	Y
25-7-10.3	0.8	N	N	Y	Y	Y	Y	Y
25-7-11.0	0.7	N	N	Y	Y	Y	Y	Y
25-7-26.4	0.5	N	N	Y	Y	Y	Y	Y
25-7-27.3	1.0	N	N	Y	Y	Y	Y	Y
25-7-21.2	4.0	N	N	Y	Y	Y	Y	Y
25-7-28.0	0.3	N	N	Y	Y	Y	Y	Y
25-7-28.2	0.4	N	N	Y	Y	Y	Y	Y
25-7-29.0	0.3	N	N	Y	Y	Y	Y	Y
25-7-13.0	0.3	N	N	Y	Y	Y	Y	Y
25-8-18.0	1.2	N	N	Y	Y	Y	Y	Y
25-8-34.0	0.5	N	N	Y	Y	Y	Y	Y
25-8-34.1	0.5	N	N	Y	Y	Y	Y	Y
26-7-8.0	1.5	N	N	Y	Y	Y	Y	Y
26-7-8.1	1.3	N	N	Y	Y	Y	Y	Y
26-7-17.0	0.2	N	N	Y	Y	Y	Y	Y
29-2-4.0	5.6	N	N	N	Y	Y	Y	Y
29-2-8.0	1.5	N	N	N	Y	Y	Y	Y
29-2-19.0	1.0	N	N	N	Y	Y	Y	Y
29-2-19.1	0.3	N	N	N	Y	Y	Y	Y
29-2-19.2A	0.7	N	N	N	Y	Y	Y	Y
29-2-19.2B	0.2	N	N	N	Y	Y	Y	Y
29-2-20.0	1.7	N	N	N	Y	Y	Y	Y
29-2-31.0	0.8	N	N	N	Y	Y	Y	Y
29-2-32.0	0.6	N	N	N	Y	Y	Y	Y
20-2-32.2	1.2	N	N	N	Y	Y	Y	Y
29-2-32.3	.9	N	N	N	Y	Y	Y	Y

Appendix 2-13
Resource Management Plan Monitoring

Introduction

The BLM planning regulations (43 CFR 1610.4-9) call for monitoring and evaluating resource management plans at appropriate intervals. The purposes of monitoring and evaluating the RMP are to:

1. Track progress of RMP implementation and assure that activities are occurring in conformance with the plan (Implementation Monitoring).
2. Determine if activities are producing the expected results and meeting stated objectives (Effectiveness Monitoring).
3. Determine if activities are causing the effects identified in the EIS (Validation).

The implementation of the Roseburg District RMP will be monitored to ensure that management actions are being implemented and are meeting their intended purposes. Specific management actions arising from proposed activity plan decisions will be compared with RMP objectives to ensure consistency with the intent of the plan. Activity plan decisions may also, however, identify monitoring plans of their own. Such plans are addressed in this RMP monitoring plan only where RMP monitoring and activity plan monitoring overlap.

Some effectiveness monitoring and most validation can only be accomplished by formal research. RMP-related research is discussed in Chapter 2 of the RMP/EIS.

Monitoring will be conducted as specified in the following sections of this appendix. Monitoring results will be reported in an "Annual Program Summary", which will be published starting the second year following initial implementation of this RMP. The annual program summary will serve as a report to the public, track and assess the progress of plan implementation, and state the findings made through monitoring as we determine if:

- management actions are resulting in satisfactory progress toward achieving RMP objectives,
- actions are consistent with current policy,
- original assumptions are valid and impacts are within the range predicted, given the reliability of the predictions,
- mitigation and corrective measures are satisfactory and serving their purposes,
- the RMP is still consistent with the plans and policies of State or local government, other Federal agencies, and Indian tribes,
- new data are available that could result in alteration or amendment of the plan,
- NEPA requirements are being met,
- compliance is being achieved on actions authorized by BLM.

Each Resource Area is responsible for the collection, compilation and analysis of much of the data gained through monitoring activities. Resource Areas will report their findings and recommendations to the District for consolidation and publication in the "Annual Program Summary."

Representative areas, such as a watershed monitoring area may be selected and established. Intensive monitoring and data collection efforts for certain resources may be made in these areas as opposed to collecting general data over the entire geographic area (which is often very expensive and provides less useful information). Attempts would be made to select representative areas that coincide for several resources.

All monitoring will follow written standards for the following, where relevant: sampling design, parameters to be monitored, analytical techniques, statistical methods for data analysis, and reporting units.

Involvement of other interested parties, including state agencies, in monitoring of plan implementation will be encouraged. This may entail coordinated monitoring efforts with parties that are able to fund their own participation in such efforts.

This monitoring plan is not static. During the life of the RMP the monitoring plan itself will be periodically evaluated to ascertain that the monitoring questions and standards remain relevant, and fine tuned as appropriate. BLM cooperation in the U.S. Environmental Protection Agency's Environmental Monitoring and Assessment Program (still under development) may specifically lead to revision of some elements of this plan.

Air Quality

Expected Future Conditions and Outputs

Compliance with the Oregon Smoke Management Plan and the State Implementation Plan, to help meet established air quality standards in accordance with the Clean Air Act.

Monitoring Questions

1. Are BLM prescribed fires contributing to intrusions into Class I areas? How frequently do intrusions occur?
2. Of intrusions that the BLM is reported to be responsible for, what was the cause and what can be done to minimize future occurrences in the future?

Standards

1. Using the Oregon Smoke Management Annual Report and any BLM smoke surveillance reports, the number of intrusions BLM certainly or possibly contributed to will be determined annually. The percentage of total units burned that contributed (or might have) to such intrusions will be calculated.
2. Reported intrusions will be individually investigated to determine the most probable cause and establish possible corrective measures.

Costs

An estimated $3000 to $5000 districtwide annually.

Soil Productivity

Expected Future Conditions and Outputs

On forest land managed for timber production soils will be managed to maintain long-term productivity by avoiding or minimizing compaction/displacement, erosion, and organic matter loss.

Monitoring Question

Are management practices maintaining soil productivity to the extent expected in the EIS?

Standards

There are three components of the soil resource which will be monitored to answer the above stated question.

1. a. Whether practices established in the RMP to achieve insignificant compaction were implemented and effective will be determined for each unit that had a compaction concern.

   b. Compaction is the primary concern when considering changes in soil physical properties. Monitoring of compaction should be accomplished on two ground based operations per resource area, and on two of high-lead units per resource area judged to be sensitive for compaction. Compaction should be assessed by establishing post treatment transect (Howes et al, 1983) and determining compacted areas. Results will be reported in percent of area compacted.

2. Two harvest units per resource area, judged to be the most sensitive for erosion (surface or mass wasting), will be monitored immediately after harvest or site preparation and again five years later. Initial information will be qualitative and obtained by visual, professional estimate. If the initial information indicates unacceptable erosion rates, the soil scientist should use a standard procedure to quantify the rate of erosion.

3. a. Whether practices established in the RMP to conserve site duff layers and organic material were implemented and effective will be determined for each unit that had a nutrition or plant available water concern.

   b. Two harvest units per resource area, judged to be the most sensitive to organic matter removal, should be monitored for organic matter removal by a qualitative, visual, and professional estimate. Stay current with research concerning long term productivity, especially studies in PNW's Long Term Productivity Project and COPE (OSU).

Costs

An estimated $4,000 per resource area annually.

Water Resources

Expected Future Conditions and Outputs

1. Resource management activities will be carried out to restore and maintain the physical, chemical and biological integrity of Oregon's waters; due regard will be given to improvements which are necessary to conserve waters for the protection and propagation of fish and aquatic life and wildlife, recreational purposes, and withdrawal of such waters for public water supply.

2. Through implementation of the Oregon Nonpoint Source Management Plan, consistent with the current Memorandum of Agreement with Oregon Department of Environmental Quality, water quality will be maintained or enhanced by prescription of site specific Best Management Practices (BMP). These BMPs will be implemented, evaluated, and monitored and appropriate adjustments or mitigation taken to assure compliance with basin specific water quality criteria (BLM iterative process).

Monitoring Questions

1. Are site specific BMPs identified as applicable during interdisciplinary review carried forward into project design and execution?

2. Are prescribed BMPs effective in maintaining or restoring water quality consistent with basin specific water quality criteria for protection of specified beneficial uses?

3. Are cumulative effects within the range anticipated in the RMP/EIS and project specific Environmental Assessments (EA)?

4. Is stream channel function (inherent stability) being affected by authorized resource management activities ?

5. Are prescribed management actions in municipal watersheds consistent with memorandums of understanding with the municipality or water purveyor?

Standards

1. Ten percent of timber sales and silvicultural projects stratified by management category will be randomly selected for monitoring to determine whether or not BMPs were implemented as prescribed. To determine whether or not water quality criteria are being met, through implementation of the BMP process, effectiveness monitoring will conducted on:

   Twenty percent of timber sales per year for appropriate water quality parameters;

   All units that are treated with herbicides and contain, or are near water;

   Other land disturbing activities, e.g., mining operations, recreation sites, or ORV use areas.

   The selection of management actions to be monitored will consider:

   a. beneficial uses likely to be impacted,

   b. which BMPs are being prescribed,

   c. the water quality criteria that are significant to the identified beneficial use(s), and

   d. what is the logical watershed area to be monitored; e.g. a timber sale unit, a municipal watershed, or the analytical watershed.

2. Three baseline watersheds will be gauged and monitored on the district. These watersheds will serve as a control for monitoring undertaken in similar areas to determine long term trends and to provide a basis of separating changes in water quality resulting from natural events from those potentially created by management actions.

   Where established, standard monitoring methods such as those reported in The National Handbook of Recommended Methods for Water-Data Acquisition and Techniques of Water-Resources Investigations of the USGS will be followed. Further, the recent EPA publication "Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska" will help guide monitoring plan development. When Rapid Bioassessment protocols are refined, these procedures will be incorporated into planned monitoring activities.

3. In addition to completing cumulative effects assessments in each environmental assessment, the Watershed Condition Index (WCI), used in the RMP/EIS, will be recalculated on the third, fifth, and seventh year of this plan to assess cumulative effects on analytical watersheds.

4. Four stream miles per year would be monitored before and after management activities occurred to determine whether stream ecosystem objectives are being met. This would involve intensive monitoring to identify levels of biological, chemical, and physical stream functions.

5. Compliance checks will be completed for all agreements entered into with providers of municipal water.

Costs

An estimated $88,000 Districtwide annually, which includes 10-year amortization of $50,000 in equipment.

Biological Diversity

Expected Future Conditions and Outputs

Contribute to maintenance of diversity of plant and animal species in western Oregon. The vegetative diversity of existing managed forest stands would increase, as to species, canopy layers and dead components. Landscape level (spatial) diversity on BLM-administered lands would be maintained or improved.

Monitoring Questions

What are the effects of BLM management on:

1. Acres of all seral stages?

2. Size and spatial distribution of old-growth blocks?

3. Retention of dead and down material?

4. Number of canopy layers?

5. Tree species composition in managed stands?

Monitoring for several other topics will also address elements of biological diversity; for example, special habitats, special status species, riparian zones, retention of wildlife trees.

Standards

1. The baseline from BLM's 1988 inventory, as updated to 1992, will be identified. Using Timber Sale Information System records and records of losses due to natural disturbance, old-growth forest reductions will be monitored at five-year intervals. Using the Operations Inventory update of approximately year 2000, acres of all seral stages will be recalculated.

2. Using the Operations Inventory update of approximately year 2000, size and spatial distribution of old-growth blocks will be calculated and compared to analysis in the 1993 RMP/EIS.

3. Twenty percent of both regeneration harvest and density management timber sales will be examined within a year after harvest and site preparation to determine number of dead and down logs by diameter class, length, and distribution. Through the decadal forest inventory, the trends of dead and down material will be identified on both managed and unmanaged stands.

4. Acres of density management accomplished will be identified in annual work plan accomplishment reports. Through the decadal forest inventory, the number of canopy layers in established stands subject to management actions during the life of the plan will be identified.

5. First, third, and fifth year stocking surveys will be used to identify tree species composition. Through the decadal forest reinventory, species composition changes in established stands subject to management actions during the life of the plan will be identified.

Costs

Item 1 costs estimated at $1,000 districtwide every five years.

Item 2 costs estimated at $1,000 districtwide.

Item 3 can be accomplished concurrent with similar monitoring for retention of wildlife trees, at an annual cost of $2,000 per resource area; its second part would be included in decadal forest inventory costs and difficult to separate.

Item 4 would negligibly affect normal data maintenance and inventory costs.

Item 5 costs estimated at $2,000 per resource area annually, in addition to traditional costs of stocking surveys.

Riparian Zones

Expected Future Conditions and Outputs

Maintenance of largely intact riparian management areas (RMA) along each side of all perennial streams.

Maintenance or improvement of habitat conditions (i.e., numbers of green trees, snags, and downed logs) within riparian management areas that provide suitable habitat for long-term productivity of fish, wildlife, and priority plants.

Monitoring Questions

1. What is the average width of RMAs established on the ground and retained following timber harvest and site preparation activities? How does it compare to the widths anticipated in the EIS?

2. Are sufficient numbers of mature conifers, snags, and downed trees retained within riparian buffers after harvest?

3. Are RMP-approved disturbances (e.g., yarding corridors) within riparian areas no more than 25 percent of stream length with RMAs in a unit? Did the logging system achieve its objective where disturbance was allowed?

Standards

1&2. Twenty percent of timber sales within each resource area will be examined prior to harvest and site preparation and re-examined following harvest to determine whether buffers were retained and their average widths. Timber sale units within watersheds identified for fish habitat or water quality monitoring will be given preference. Average widths will be determined by measurement at approximately equidistant points along the affected stream reach within each sale unit. Trees, snags and downed woody material retained within buffers will be counted before and after timber harvest and site preparation according to the species and size class. Ground cover of herbs and shrubs will be measured in transects or one-square-meter plots.

2. In conjunction with experimental drainage established for fish habitat monitoring, one undisturbed (or essentially so) riparian study site will be established within a representative watershed established within each resource area. The study site will be used as a baseline from which to compare riparian areas impacted by timber harvest related activities. The changes in habitat conditions will be monitored once during the life of the plan (or after a major land disturbance activity such as blowdown).

3. The extent of the disturbed area along the stream will be measured and compared to RMA length in the unit. The degree of disturbance will be compared to logging plan objectives.

Costs

An estimated $ 10,000 per resource area annually.

Retention of Wildlife Trees

Wildlife trees per acre (comprised of snags and green trees per acre), well distributed within harvested units to provide habitat for cavity nesters. Wildlife trees should have a diameter of at least 16 inches (or if 16 inch trees are unavailable, a minimum diameter of 12 inches), and should be at least 15 feet high. Maintain habitat for cavity nesting birds at 60 percent of potential dominant woodpecker population levels or higher.

Monitoring Questions

Are suitable (numbers, heights, and diameter classes) snags and replacement trees being left, suitably distributed, to achieve the habitat necessary to attain the 60 percent population level districtwide?

Standards

Every five years the population level of dominant woodpeckers sustainable by BLM habitat will be assessed using the analytical technique used in the RMP/EIS to assess the capability of the alternatives. In addition, 20 percent of regeneration harvest timber sales in each resource area will be examined by pre- and post-harvest (and after site preparation) inventories to determine snag and green tree numbers, heights, average diameters, and distribution within harvest units. The measure of distribution of wildlife trees will be the percent of this material in the upper, middle and lower thirds of the sale units monitored. Wildlife trees left following timber harvest activities (including site preparation for reforestation) will be compared to those that were marked prior to harvest.

Costs

An estimated average of $6,000 per resource area annually.

Roosevelt Elk

Expected Future Conditions and Outputs

Maintain elk habitat effectiveness indices (HE_s, HE_r, HE_c, and HE_f according to Wisdom Model) on BLM-administered lands at levels equal to or exceeding within each (elk management area) (watershed).

Monitoring Question

Are elk habitat effectiveness indices on BLM administered lands at expected (in the RMP/EIS) levels within each elk management area (or watershed)?

Standards

Elk habitat effectiveness indices on BLM-administered land will be calculated within analytical elk management areas every three years (using GIS).

Costs

An estimated $9,000 every three years districtwide.

Special Habitats

Expected Future Conditions and Outputs

Maintenance of undisturbed conditions in each special habitat (i.e., meadows, wetlands, cliffs etc.), plus undisturbed conditions in buffers at least 100 to 200 feet wide around the Special Habitat area.

Monitoring Questions

Is BLM protecting special habitats as provided in the RMP? Is the average width of undisturbed buffers retained following timber harvest and site preparation activities as specified in the RMP?

Standards

Twenty percent of BLM actions on lands containing or near special habitats within each resource area will be examined to determine whether special habitats were protected as provided in the RMP. Determine average buffer widths by measurement at approximately equidistant points around the affected special habitat within each sale unit.

Costs

An estimated $ 3,000 annually per resource area.

Fish Habitat

Expected Future Conditions and Outputs

Maintenance and enhancement of fish habitat with diversity and quality capable of maintaining or enhancing populations of anadromous and resident salmonoid game and priority nongame fish species.

Improvement of spawning and rearing habitat and increase of large woody debris levels.

Monitoring Questions

1. Is fish habitat in terms of quantity and quality of rearing pools and over-wintering habitat, and smolt production being maintained or improved as predicted?

2. Is large woody material being retained in the stream channel for fish habitat?

Standards

1. At least one experimental drainage per resource area will be identified to monitor long term riparian and instream habitat and fish populations (the drainage should be at least five square miles in size, contain at least 50 percent BLM land). Monitoring will include riparian and instream habitat inventories of all streams used by salmon and/or trout. Outmigrating fish population estimates will be determined for the basin. Index areas will be established for adult spawning escapement. Habitat and summer fish surveys should be conducted using a micro-habitat system that is similar to or currently being used by Western Oregon Districts (Monitoring Western Oregon Records of Decision H-1734-1, 1986). This is comparable to ODFW research and Hankin and Reeves methodologies. Adult spawning ground counts will be conducted annually to procedures similar to ODFW index streams.

2. All streams supporting salmonids will be sampled once every ten years for changes in riparian and instream habitat conditions.

Costs

An estimated $13,000 per resource area annually, plus initial costs for equipment of $3000.

Special Status Species

Expected Future Conditions and Outputs

Conservation or recovery of special status species and their habitats so that listing under the Endangered Species Act (ESA) is not needed.

Monitoring Questions

1. Are BLM actions and BLM authorized actions designed and executed to protect or enhance special status species and/or their habitat to the extent required by the ESA, Bureau policy, or directed in the RMP?

2. Are the mitigation and protection measures employed effective?

Standards

1. Annually 20 percent of the files on each year's timber sales and other relevant actions (e.g., rights-of-way, instream structures) will be reviewed to evaluate documentation regarding special status species and related recommendations and decisions in light of ESA requirements, policy and RMP decisions. If mitigation was required, review will ascertain whether such mitigation was incorporated in the authorization document. The relevant actions will be reviewed on the ground after completion to ascertain whether the mitigation was carried out as planned.

2a. Habitat conditions will be monitored at all or a representative sampling of known sites of all listed, proposed, candidate, state listed, and Bureau sensitive plant and animal species identified as occupying sites potentially affected by Bureau actions, both before and within a year after site disturbance and/or at intervals of at least five-years. Population trends of plants in those categories at such sites will also be monitored. Such monitoring will particularly evaluate effectiveness of mitigating measures.

2b. Northern spotted owl monitoring will focus on population characteristics on BLM-administered lands throughout the range and on habitat condition and trend relative to BLM's management strategy.

Population monitoring will be an adaptation of ongoing BLM efforts which would conform to recommendations in the final recovery plan, after it is adopted. The draft recovery plan released by the Fish and Wildlife Service recommended that monitoring should involve five initiatives under a comprehensive program. These are as follows:

- Roadside survey of territorial birds: Survey would provide census or index data on territorial owls relative to a spectrum of habitat abundance strata.
- Owl activity site monitoring: Specific surveys of known sites would provide information on occupancy, reproduction, turnover rates, and survival.
- Transmitter studies of dispersing juveniles, and territorial and non-territorial adults: The use of radiotelemetry systems would provide specific information on movements of dispersing juveniles and the habitats of non-territorial birds in relation to territorial population.
- Other related studies: Additional work beyond that already described would explore elements such as age ratios of first time breeders and the further development of landscape level computer models.
- Coordinations and integration of the above initiatives: A specific effort will organize and interpret results from all aspects of the monitoring program to assemble information in a form that will permit evaluation of management and modification of the recovery plan, if necessary, along with data to support delisting, when appropriate.

Habitat monitoring will determine whether the BLM's land allocations and prescriptions are implemented as planned. Additional efforts will track whether habitat condition and trend patterns track those predicted and meet the expectations ofthe prescriptions employed to provide the desired habitat condition.

Costs

An estimated $2,000 per resource area annually for No. 1.

For No. 2 the following districtwide:

- plants - $2,000 per site each year visited.
- spotted owls - $300,000 annually districtwide.
- other special status wildlife - $100,000

Areas of Critical Environmental Concern (ACEC)

Expected Future Conditions and Outputs

Maintenance of ACECs in accordance with the objectives established for them, to protect the values for which they were designated.

Monitoring Questions

1. Are BLM actions and BLM authorized actions consistent with RMP objectives for designated ACECs?
2. Are the special values of ACECs being maintained?

Standards

1. All actions within and adjacent to ACECs will be reviewed to determine whether the possibility of impacts on ACEC values was considered, and whether any mitigation identified as important for maintenance of ACEC values was required and, if so, was actually implemented.
2. Each ACEC will be monitored annually to determine if unauthorized uses are occurring and whether ACEC values are being maintained.

Costs

An estimated annual average of $13,000 districtwide.

Visual Resources

Expected Future Conditions and Outputs

Preservation of existing visual qualities in all areas designated by Congress for exclusive management (i.e. VRM Class I areas) and conservation of visual qualities in areas within one quarter mile of recreation sites, highways, state scenic waterways, and wild and scenic rivers (i.e. VRM Class II and III areas).

Monitoring Question

Are management actions (primarily timber sales) in VRM Class II and III areas meeting or exceeding visual resource management class objectives?

Standards

All timber sales and other selected projects in VRM Class II areas and 25 percent of sales or projects in Class III areas that have special design features or mitigating measures for visual resource protection will be monitored to evaluate the effectiveness of the practice used to conserve visual resources. The method will consist of a post timber harvest or project construction visit to evaluate success or failure based on professional judgement. In VRM Class II management areas, where two or more sales or actions have occurred, impacts will be monitored to determine total cumulative impacts at a minimum interval of five years.

Costs

An estimated $2000 per resource area annually.

Reforestation and Timber Management Practices

Expected Future Conditions and Outputs

Timber sale levels are as projected in the RMP/EIS. Design and logging of timber sales under the constraints of the RMP is feasible. Harvested units are reforested at a stocking level and managed at an intensity which attains growth and yield that will achieve projected outputs.

Monitoring Questions

1. Are timber sale volumes and harvest acres as projected in the RMP/EIS?
2. Has BLM been able to design and sell timber sales that meet the standards set forth in the RMP, on all categories of lands where sales were expected during the life of the plan?
3. Were the acres receiving management practices (e.g., planting with genetically selected stock, fertilization release, and thinning) as projected in the RMP/EIS?
4. Is reforestation achieving desired stocking, particularly in connectivity areas?
5. Are stands growing at a rate that will produce the predicted yields?

Standards

1&3. Annual timber sale volumes and acres to be harvested will be identified in annual work plan accomplishment reports.

2. An annual districtwide post mortem will address whether the district was able to offer and sell timber sales that meet RMP standards.
4. First, third, and fifth year stocking surveys will be used.
5. Managed stand inventory (as part of the decadal forest inventory) will provide actual growth data to be reported once every 10 years.

Costs

An estimated $18,000 per resource area annually to conduct this level of monitoring.

Rural Interface Areas

Expected Future Conditions and Outputs

BLM land within a quarter mile of identified rural interface areas zoned for one to twenty acre lots is managed in such a manner as to mitigate adjacent land owner concerns when reasonable to do so. Forest management practices are altered when reasonably feasible.

Monitoring Question

Are we managing rural interface areas consistent with management practices identified for these areas in the RMP?

Standards

All actions within a quarter mile of the identified rural interface areas will be examined to determine if special project design features and mitigation measures are implemented as planned.

Costs

An estimated $4,000 districtwide annually.

Socioeconomic Conditions

Expected Future Conditions and Outputs

Contribution to local employment and county revenues by providing outputs that support approximately 1090 jobs and $1,151,070 annually of payments to the O&C counties, (and $53,400 annually of CBWR payments).

Monitoring Questions

1. What level of local employment is supported by BLM timber sales and forest management practices?
2. What were O&C payments to counties (and CBWR payments)?

Standards

1. Using current multipliers, annual BLM timber sales and harvest volume will be related to supported employment. Similarly, labor-intensive management practices each year will be related to jobs.
2. Annual O&C (and CBWR) payments will be reported.

Costs

An estimated $ 1,000 annually districtwide.

Appendix 2-14
Goals and Objectives of the Preferred Alternative

Goals

Manage lands to contribute to community stability consistent with maintenance of ecosystems and a diversity of species; contribute to long-term recovery of the northern spotted owl; and maintain fish and wildlife habitat, and recreation, scenic and other resources.

Objectives

Produce a moderate sustained yield of timber.

Manage biological diversity, provide regional and subregional connectivity, and contribute to recovery of the northern spotted owl, using a system that maintains and enhances old-growth and mature forest in areas considered most important for recovery of the northern spotted owl and links those areas with lands managed to provide connectivity.

Protect habitats of threatened and endangered species. Protect habitats of species with high potential for listing and species of related concern, to maintain their populations at a level that would avoid endangering the species.

Retain existing RNAs and ACECs. Provide new ones from eligible areas where needed to maintain or protect important values.

Manage scenic resources in selected high use area.

Provide substantial protection for anadromous fish habitat, other perennial streams, and other water environments.

Provide for a wide range of developed and dispersed recreation opportunities, consistent with maintenance of ecosystems and a diversity of species, to minimize conflicts among recreation user groups.

Make land tenure adjustments to benefit a variety of uses and values.

Adopt appropriate special forest management practices on BLM administered lands close to Rural Interface Areas.

Preferred Alternative - This alternative would manage lands to contribute to community stability consistent with maintenance of ecosystems. It would manage biological diversity, provide regional and subregional connectivity, and contribute to long-term recover of the northern spotted owl. Habitats of other threatened and endangered species would be protected. Species of related concern would be protected sufficiently to avoid endangering the species. Timber harvest would not be planned in or adjacent to riparian zones of important waters. Six existing Special Areas would be retained, four existing Special Areas would be expanded, and two new Special Areas would be designated.

Scenic resources would be managed in selected special status and high use areas. Recreation management would provide for a wide range of recreation opportunities. Special timber harvest and forest management practices would be applied in Rural Interface Areas.

Appendix 2-15
Proposed Research Topics

The following list of research topics would be modified based upon available funding and changing knowledge and priorities.

Water

Refine/evaluate a cumulative impact and analysis model to assess effects of various management activities (including identification of hydrologic recovery rates) in third to fifth order watersheds.

Identify roles of first and second order streams on the overall productive capability of the aquatic ecosystem, and the effect of different management presecriptions.

Biological Diversity

Assess the effectiveness of silvicultural systems and silvicultural practices in the retention or enhancement of biological diversity within a forest enviornment managed for the production of timber and other commodity values.

Develop improved indices and methods for measuring and describing both the diversity of habitats and species on forest sites and in determining the effect of silvicultural systems on ecosystem processes, wildlife and plant populations, and species survival.

Evaluate the effectiveness of sivicultural practices and forest genetics programs in retaining the genetic diversity of managed forests, including both improved conifer species and other organisms.

Assess the effects of natural fire, prescribed fire, and fire exclusion on the structures and functions of western Oregon ecosystems and upon habitat connectivity.

Assess a variety of silvicultural practices, structural retention levels, density management regimes, and species mixes on the stability and health of forest ecosystems.

Wildlife

Develop inventory methods for minor species.

Define habitat requirements and preferences of amphibians and reptiles (particularly those that are special status species).

Identify how management activities affect those species and what management prescriptions can minimize impacts on them.

Identify how spotted owls respond to alternative timber harvest prescriptions.

Identify how landscape level habitat patterns in the checkerboard ownership pattern affect spotted owl occupancy, reproduction, survival, and juvenile dispersal.

Identify the vegetation structure characteristics and histories of forest stands used by spotted owls as foraging habitat.

Riparian Zones

Assess the effect of different buffer widths and compositions, and the influence of differing management prescriptions on adjacent lands, on the plants and animals of the riparian zone.

Fish

Assess the effectiveness of various riparian protection prescriptions for maintaining natural stream processes, especially as it relates to production of anadromous and resident fish.

Assess the effects of fish habitat improvement projects on aquatic invertebrate fish food sources, as well as fish populations, and the useful life of the projects.

Forestry

Assess effects of managing stand structure to meet a variety of forest management objectives including the practicality of producing old-growth forest features within shorter rotations.

Determine and improve reforestation, species diversity, timber yield and ecosystem process results associated with a variety of silvicultural systems.

Assess nonconiferous vegetation in partial cut forest stands, the effect of such vegetation on conifer reforestation, and the developmenet of effective ecosystem based strategies for the affordable management of such vegetation.

Chapter 3
Appendices

Appendix 3-1
Existing Withdrawals and Classifications

Withdrawals

Authority[1]	T	Location R	S	Acreage[2]	Purpose	Segregative Effect[3]	Surface Management Agency
PSR* 629,	20S	7W	25	200.00	Protect Water	C	BLM/FERC[4]
WPD* 11			27	40.00	Power & Reservoir		
			33	280.00	Development		
			35	80.00	Potential		
PLO 3869	21S	6W	1	80	Gunter Recreation Site	B	BLM
PSR* 629,	21S	7W	5	352.59	Protect Water	C	BLM/FERC[4]
WPD* 11			9	40.00	Power & Reservoir		
					Development		
					Potential		
WPD* 15,	22S	5W	33		Transmission Line	C	BLM/FERC[4]
PSR* 658					Purposes (unconstructed)		
PSR* 633,	22S	7W	19	29.93	Protect Water	C	BLM/FERC[4]
WPD* 11			31	17.52	Power & Reservoir		
					Development		
					Potential		
PSR* 280,	23S	7W	15	94.00	Protect Water	C	BLM/FERC[4]
633,			23	134.27	Power & Reservoir		
WPD* 11			27	74.20	Development		
			32	1.70	Potential		
			33	118.20			
PSR* 280,	24S	7W	3	146.05	Protect Water	C	BLM/FERC[4]
633,			11	186.32	Power & Reservoir		
WPD* 11			13	26.62	Development		
			15	122.19	Potential		
			17	116.06			
			20	14.35			
			21	75.58			
			23	40.03			
			28	34.62			
			33	95.20			

Appendix 3-1 cont.

Withdrawals

Authority[1]	Location T	R	S	Acreage[2]	Purpose	Segregative Effect[3]	Surface Management Agency
PLO 3869	24S	7W	13	23.70	Tyee Recreation Site	B	BLM
PLO 754	24S	7W	20 21	14.35 13.93	Timber Preservation	A	BLM
PLO 3869	25S	1W	23 24 25	20 40 20	Scaredman Recreation Site	B	BLM
Executive Order* 865	25S	1W	27 30	200 40	Umpqua National Forest	None	USDA,FS[6]
PLO 3869	25S	2W	15	160	Rock Creek Recreation Site	B	BLM
			21	320	Mill Pond Recreation Site	B	BLM
PSR* 280, 630, 633, WPD* 11	25S	7W	5 6 7 9 15 17 21 23 27	37.00 105.25 205.49 78.39 13.83 80.00 40.00 80.00 80.00	Protect Water Power & Reservoir Development Potential	C	BLM/FERC[4]
PLO 4537	25S	7W	9 10 15	78.40 0.15 13.33	Umpqua Recreation Site	B	BLM
PSC* 162,	25S	8W	12	20.80	Protect Water Power & Reservoir Development Potential	C	BLM/FERC[4]
Public Law* 100-557	26S	2W	7,8,13,14, 15,16,17, 18,20,21, 22,23,24	1620	North Umpqua Wild and Scenic River	C	BLM

Appendix 3-1 cont.

Withdrawals

Authority[1]	Location T	R	S	Acreage[2]	Purpose	Segregative Effect[3]	Surface Management Agency
PP 1927*	26S	2W	7		Electric	B	BLM/FERC[4]
			13		transmission line.		
			14		Occupies 100 foot		
			15		wide strip of land.		
			17				
			21				
			29				
			30				
			31	110.11			
PSC* 416,	26S	2W	7	397.30	Protect Water	C	BLM/FERC[4]
PSR* 631, 280			13	40	Power & Reservoir		
WPD* 11, 16			14	300	Development Potential		
			15	160			
			17	280			
			21	33.78			
			22	220			
			23	353.94			
			24	250			
PLO 3869	26S	2W	14	160	Susan Creek Falls	B	BLM
			23	45.21			
PP* 1927	26S	3W	1	5.88	Electric Trans-	B	BLM/FERC[4]
			35	6.29	mission line. Occupies		
					100 foot wide strip of		
					land.		
PLO 4848	26S	3W	1	80	Swiftwater	B	BLM
					Recreation Site		
PLO 3869			9	6.44	Lone Rock	B	BLM
PSR* 631,	26S	3W	1	120	Protect Water	C	BLM/FERC[4]
280			9	25 +	Power & Reservoir		
WPD* 11			11	121.44	Development Potential		
SO Intpr* 83							
PSR* 631,	26S	4W	17	11.56	Protect Water	C	BLM/FERC[4]
WPD* 11					Power & Reservoir		
					Development Potential		

Appendix 3-1 cont.

Withdrawals

Authority[1]	Location T	R	S	Acreage[2]	Purpose	Segregative Effect[3]	Surface Management Agency
PSR* 280, 633, WPD* 11	26S	6W	7	139.87	Protect Water Power & Reservoir Development Potential	C	BLM/FERC[4]
			8	62.43			
PLO 4521	27S	2W	1	0.80	Negro Creek Road	B	USDA,FS
Executive Order* 865	27S	2W	9	320.4	Umpqua National Forest	None	USDA,FS
			32	110.25			
			33	308.03			
PLO 4848	27S	2W	1	80	Emile Creek Recreation Site	B	BLM
			8	80	Little River Wayside	B	BLM
PLO 3869			16	178.53	Wolf Creek Trail	B	BLM
PLO 3869	27S	3W	23	80	Cavitt Creek	B	BLM
Executive Order* 865	28S	2W	30	320.15	Umpqua National Forest	None	USDA,FS
PLO 4448	29S	7W	17	40	Umpqua River Reclamation Project	B	BR[5]BLM
			21	20.22			
PSR* 659, WPD* 14	29S	9W	35	40	Protect Water Power & Reservoir Development Potential	C	BLM/FERC[4]
PLO 4448	29jS	7W	32	58.43	Umpqua River Reclamation Project	B	BR[5]BLM
PSC* 198, 315, PSR* 280,	30S	2W	12	80	Protect Water Power and Reservoir Development Potential	C	BLM/FERC[4]
			23	80			
			28	40			
			29	120			
			31	80			
PLO 4626	30S	2W	23	1.3	Pickett Butte Road	B	USDA,FS
PSC* 315, PSR* 659,	30S	3W	19	120	Protect Water Power and	C	BLM/FERC[4]
			25	120			

Appendix 3-1 cont.

Withdrawals

Authority[1]	Location T	R	S	Acreage[2]	Purpose	Segregative Effect[3]	Surface Management Agency
WPD* 11			29	80	Reservoir		
			31	164.62	Development		
			33	40	Potential		
			35	80			
	30S	4W	15	99.34	Protect Water	C	BLM/FERC[4]
			21	80.14	Power and		
			23	161.95	Reservoir		
			25	112.76	Development		
			27	40.00	Potential		
			29	76.84			
			35	167.76			
PLO 4448,	30S	7W	5	20	Umpqua River	B	BR[5]
			6	31.15	Relcamation		
					Project		
PSR 659, WPD 14	30S	9W	3	40	Protect Water Power and Reservoir Development Potential	C	BLM/FERC[4]
PSC* 315	31S	3W	3	83.61	Protect Water Power and Reservoir	C	BLM/FERC[4]

Appendix 3-1 cont.

Classifications

Authority[1]	Location T	R	S	Acreage[2]	Purpose	Segregative Effect[3]	Surface Management Agency
					Development Potential		
PLO 3869	31S	8W	35	20	Darby Creek Recreation Site	B	BLM
PLO 5490	All Public Domain (PD) lands			18,426	Multiple Use	D	BLM
Small Tract Act	T 24 S, R 7 W, Sec 3; Lot 3			4.43	Community Site Lease OR 011654	B	BLM
Recreation and Public Purpose Act	T 26 S, R 2 W, Sec 7; $E\frac{1}{2}SE\frac{1}{4}$			7.50	County Park Lease OR 012162	B	BLM
Recreation and Public Purpose Act	T 26 S, R 2 W, Sec 23 and 24; Metes and Bounds			147.99	State Park Lease (expired) OR 010044	B	BLM
Small Tract Act	T 28 S, R 7 W, Sec 15; Lot 6			2.69	Occupancy Lease OR 05564	B	BLM
Small Tract Act	T 28 S, R 4 W, Sec 13; $SE\frac{1}{4}NE\frac{1}{4}$			0.61	Occupancy Lease OR 16775	B	BLM

Segregative Effect Acreage Summary[3]:

	A	B	C	D
District Total:	**28.28**	**1,943.65**	**9,102.53**	**18,426.00**

*Withdrawals remaining to be reviewed through the FLPMA withdrawal review process.

[1] Authority Abbreviations:
- PLO - Public Land Order
- PSC - Power Site Classification
- PSR - Power Site Reserve
- WPD - Water Power Designation
- PP - Power Project
- SO Intpr - Secretarial Order Interpretive

The Water Power Designations, Power Site Reserves, Power Site Classifications and S.O. Interpretative Withdrawals have similar segregations. These withdrawals are listed together on a township basis. Note all of the listed withdrawals apply to every section listed under that township.

[2] Table does not include lands that have been transferred out of federal ownership subsequent to withdrawal which are subject to Section 24 of the Federal Power Act (U.S. Congress 1920).

[3] Segregative Effect:
A. Withdrawn from operation of the general land laws, the mining laws and the mineral leasing laws.
B. Withdrawn from operation of the general land laws and the mining laws.
C. Withdrawn from operation of the general land laws only.
D. Withdrawn from operation of the general land laws, but not from the R&PP Act (U.S. Congress 1926), sales or exchanges.

[4] Federal Energy Regulatory Commission.
[5] Bureau of Reclamation.
[6] US Department of Agriculture, Forest Service

Appendix 3-2
Right-of-Way Agreements

Right-of-Way Agreements

Permittee Name	Permit Number	Date Signed
Anderson	790	9/18/64
Aarant	920	12/15/78
Bate	M-832	9/3/65
Madison-Beck	711	7/3/63
Bellows	784	3/1/66
Bohemia	938	11/17/72
Boucock	710	5/10/63
Brand S. Corp.	854	8/15/67
Brazier	1083	5/30/80
Byron-Moody	1154	12/5/86
Champion Int.	490	8/22/58
Champion Int.	573	8/18/60
Champion Int.	642	4/3/62
Champion Int.	646	4/3/62
Champion Int.	656	4/3/62
Champion Int.	697	11/19/62
Champion Int.	769	7/7/64
Champion Int.	773	7/6/64
Champion Int.	788	2/1/65
Champion Int.	791	2/1/65
Champion Int.	912	1/17/75
Champion Int.	913	8/17/77
Dodd	906	12/5/69
Douglas Co. Lbr.	526	9/9/59
Dysert	744	8/2/63
Engle Const.	1113	11/22/82
Ford, Kenneth	680	5/8/63
Glide Lbr.	1143	11/26/85
Hancock	565	7/20/60
Haines	589	3/3/61
Harris	581	5/1/61
Hendy	674	4/24/63
Holmes Bros.	809	7/20/65

Right-of-Way Agreements (cont.)

Permittee Name	Permit Number	Date Signed
Hunt	1117	6/3/82
International Paper	659	7/1/64
International Paper	711	7/3/63
International Paper	976	1/28/81
Keller	792	12/8/65
Little River Box	926	8/11/71
Lone Rock Timber	543	4/8/60
Lone Rock Timber	585	12/15/60
Lone Rock Timber	700	11/7/62
Lone Rock Timber	767	5/15/64
Lone Rock Timber	768	9/17/64
Lone Rock Timber	914	1/12/70
Mach	845	12/20/67
Mazama	1082	7/17/80
McKenzie	1179	1/6/89
Messing	1110	1/6/89
Michaels	798	3/25/65
Monger	765	4/2/64
Murphy Co.	1115	4/21/82
Newton	1160	5/4/87
Nickel Mtn. Resources	1163	2/14/89
Ray, Darryl	600	1/13/61
Reservation Ranch	1145	7/2/86
Roseburg Resources	531	12/10/59
Roseburg Resources	617	2/20/66
Roseburg Resources	700	11/7/62
Roseburg Resources	735	2/10/64
Roseburg Resources	751	7/7/64
Roseburg Resources	851	8/15/67
Ross	1149	7/6/89
Silver Butte Lbr.	R-824	12/20/66
Silver Butte M&M	1099	5/12/81
Starfire Lbr. Co.	1178	1/12/89
South Fork Lbr.	548	7/13/60
Suntal Trust	640	10/5/61
Superior Logging	1023	12/15/77
U.S.F.S.	724	3/14/61

Right-of-Way Agreements (cont.)

Permittee Name	Permit Number	Date Signed
Warren & Davis	672	11/14/63
Weyerhaeuser	540	3/11/60
Weyerhaeuser	698	2/14/66
Weyerhaeuser	863	8/15/69
Weyerhaeuser	957	3/5/74
Weyerhaeuser	1022	2/10/78
Whipple	715	3/7/63
Whipple	846	5/2/67
Wilson	664	6/1/62
Wood & Sons	664	6/5/62
Norman Wood	832	5/17/66
Woolley Ent.	645	7/18/62
Woolley Ent.	763	1/28/65
Zellner	571	8/8/60

Appendix 3-3 Water Resources

Summary of Basic Principles

The beneficial uses of water resources primary concern related to land management activities are rearing and spawning habitat for salmonids, domestic water supply, fishing, and water contact recreation. In all of these uses, high quality water is important.

Forest hydrology is a collection of complex processes which transform precipitation to streamflow or groundwater.

Precipitation

Oregon's latitude, topography and location near the Pacific Ocean have a great influence upon its climate. The Coast Range and Cascade mountains play a major role in rainfall patterns. As moisture-laden air travels inland from the ocean, it ascends to cross the mountains. As it rises, the moisture cools and condenses, falling as rain or snow. Large accumulations of snow occur during winter months in the higher elevations, generally above 4,000 ft.

Oregon's rainfall pattern gives BLM's Roseburg District a plentiful water supply during October through May, when 92 percent of annual precipitation is received. June through September are generally dry months. This is because in winter the active Pacific storm systems move south, providing frequent rain, while in summer the storm track moves north into Canada. This gives the Roseburg area lots of sunny, warm to hot summer days. The annual precipitation in the district ranges from a high of 80 inches to a low of 30 inches.

Precipitation is an important climatic variable that influences the productivity and management of forest lands. The distribution of vegetation and the rates of forest growth are strongly affected by the generally moisture-limiting, mediterranean climate of the Roseburg District. Estimates of precipitation are used for planning numerous forest management activities such as the location, design and maintenance of forest roads, and the selection and scheduling of harvesting and reforestation systems.

Interception occurs when rain or snow lands on vegetation rather than the ground. Some of this intercepted water evaporates and the remainder falls to the ground. Evaporation of water also occurs from surfaces of water bodies and soil surfaces. Under forested conditions, evaporation from soil surfaces is minimal. The process by which water is taken up by plants and discharged to the atmosphere is known as transpiration.

Infiltration is the movement of water into the soil surface. When the rainfall rate exceeds the rate of infiltration, water will travel over the ground surface to a channel. This is known as overland flow. Infiltration rates usually far exceed the maximum rates of rainfall in undisturbed forest soils in western Oregon, thus allowing all water that reaches the earth's surface to enter the soil.

Infiltration rates are reduced by soil disturbing activities such as road building and tractor logging. These activities tend to compact the soil surface causing some water to flow overland until it reaches nearby undisturbed soils or a stream channel.

Removal of forest vegetation drastically reduces the amount of precipitation which returns to the atmosphere as a result of interception and transpiration. This allows more precipitation to reach the soil surface and drain into streams or become groundwater. The return of vegetation results in annual streamflows decreasing to preharvest levels as both interception and transpiration increase. Evaporation from the soil surface is generally increased after timber harvest, however, this increase is greatly offset by the reduction in transpiration.

Streamflow

The amount of water draining from a given area in a year is referred to as the annual water yield and is usually expressed in acre-feet (43,560 cubic feet) or the average depth over an area in inches. The annual yield of an area can be converted to the average annual flow (in cubic feet per second (CFS)) of the stream draining the area.

Streamflow is the water which reaches the stream channel. Total streamflow is a product of all the other processes in the hydrologic cycle. Distribution of annual streamflow in western Oregon is closely related to the distribution of annual precipitation, thus high flows are observed during the winter and low flows are predominant in the summer.

The effect of timber management activities (road construction, timber harvest, and slash disposal) on streamflow in small headwater basins is primarily related to removal of forest vegetation and disturbance of the natural soil surface. Studies of clearcutting small watersheds in western Oregon showed that annual water yields from clearcut areas increased 26 to 43 percent (Harris 1977; Rothacher 1970; Harr et al. 1979).

The amount of increase in streamflow resulting from removal of forest vegetation is proportional to the type of harvest, the area harvested within a specific watershed, and the time since harvest. Streamflow increases are most noticeable in small watersheds which have large areas of vegetation removed over a short time period. Streamflow increases in large basins tend to be masked because the non-vegetated area is small relative to the size of the basin.

The duration of increased water yield is not easily predicted; however, Harr (1983) found that 27 years (30 years in SW Oregon) would be required for water-yield increases to disappear. Increases in streamflow due to vegetation removal are not distributed evenly throughout the year. Increases in summer flows appear large when compared to the naturally low levels of streamflow during the summer months. The increases in summer streamflow result from greatly reduced transpiration allowing more water to drain through the soil to the streams. Summer increases are relatively short-lived because of the rapid growth of vegetation along stream channels.

Increases in streamflow following timber removal are greatest in fall because soil moisture content on the harvested areas is higher than it was under forested conditions. Therefore, a smaller amount of fall rains is used for soil moisture recharge and a larger proportion becomes streamflow. Timber removal has little effect on the size of large peak flows which cause extensive downstream flooding. Large peak flows are caused by such great amounts of precipitation that differences in soil moisture content between harvested and forested areas become insignificant and both areas respond nearly the same.

Soil disturbance may have an influence on the frequency and magnitude of small and large peak flows. The degree of influence depends upon the amount of area compacted by haul roads and tractor skid roads, and the proximity of the compacted area to stream channels.

Recent watershed studies have shown that timber harvest in the transient snow zone has increased the magnitude of peak flows. The transient snow zone is located at elevations where the snow level fluctuates throughout the winter in response to alternating warm and cold fronts. In the Roseburg District the transient snow zone has been observed between elevations of 2,000 and 5,000 feet. Snow accumulation is greater in clearcut openings than in undisturbed forest. Rain-on-snow events result in rapid melting of these shallow snowpacks. More snowmelt is generated from clearcut openings than from forested areas resulting in larger peak flows.

Streamflow does not always increase following the removal of vegetation. In some areas, reduced fog interception and drip following logging apparently reduces annual precipitation enough to offset expected reductions in transpiration. In coastal areas, fog drip may account for as much as 30 percent of the total water reaching the forest floor; thus, removal of forest vegetation may actually decrease annual streamflow (Harr, 1983B).

Water Quality

Stream temperature, turbidity, sediment, dissolved oxygen, and chemical water quality are important water quality parameters to observe, since they indicate the ability to protect those beneficial uses listed in the OAR, Chapter 340-41.

Streams flowing from undisturbed forests generally have excellent quality. This characteristic makes streams valuable for domestic water supply, fish production and recreation. Natural processes such as surface erosion, landslides and flood events can increase sediments in stream channels, causing a detrimental effect on water quality.

Sediment and water temperature are the two water quality factors influenced most by timber harvest and road construction.

Units of Measurement

Water temperature is measured in degrees Fahrenheit (°F) or degrees Celsius (°C); turbidity is measured in Jackson or Nephelometric Turbidity Units (JTU or NTU); conductivity is measured in microseimens (uS);

and bacteria are measured in number of organisms per 100 milliliters (Ml). Most chemical parameters of interest, as well as most sediment data, are reported in terms of concentrations, discharge, or yield. Water quality data is usually reported as concentrations or weight per unit volume (usually milligrams per liter (mg/l) or micro-grams per liter (ug/l). In the dilute waters of western Oregon, mg/l equals parts per million (ppm), and micro-grams per liter equals parts per billion (ppb). Frequently, in the case of sediment and occasionally in the case of chemicals, data is expressed in terms of discharge (i.e., weight or volume per unit time tons per day or cubic feet (cf) per year). Occasionally sediment or chemical data is also expressed as yield (i.e., weight or volume per unit area of the watershed-tons per acre or acre-feet per square mile or kilograms per hectare).

Stream Temperature

Timber harvest affects stream temperature by removing shading vegetation from streambanks. Stream temperature increases of 10° F or more have been recorded following removal of streamside vegetation by clearcutting and burning in both the Oregon Cascades and Coast Range (Brown and Krygier 1970; Leuno and Rothacher 1969). Because downstream shading does not significantly lower temperatures of streams warmed by upstream exposure (Brown, 1970), water temperatures of larger streams can also increase when small tributaries are exposed by clearcutting. The magnitude of this effect is dependent on the temperature and quantity of groundwater inflow, as well as inflow from other well-shaded tributaries. The primary concern with water temperature increases is the potential for detrimental effects on fish and other aquatic organisms.

Chapter 340 of the OAR sets standards for water temperature in streams. These standards require no measurable increases when stream temperatures are 58° F or greater, and in no case may the increase in water temperature be more than 2°F. For application of the standards, maximum summer stream temperatures may be estimated with an equation developed by Schloss (1985), and temperature increases from removal of shading vegetation may be estimated from an equation developed by Brown (1970). Recent computer models, such as the one developed by Beschta (1984), may be used to estimate both ambient stream temperatures and changes resulting from management, for both individual stream reaches and networks of streams.

Sediment

The larger peak flows described above have a direct relationship to increases in the amount of sediment transported downstream.

Peak flows may result in streambank erosion and scouring of channel beds. Forestry practices may also influence sediment entering streams by causing surface erosion or landslides. The occurrence of surface erosion or landslides resulting from forest management activities is dependent on natural rates of surface erosion and landslide frequency, climatic factors and the type of activity. Landslide prone areas are avoided if possible in timber harvest and road construction. Roads continue to be a major source of stream sedimentation, although improved methods for design, location, construction and resurfacing of dirt road with rock over the past 10 years have greatly reduced the amount of sediment contributed by roads.

Sediment clouds water, chokes fish gills, blankets fish spawning areas and smothers bottom aquatic habitats. Sediment also increases the cost of treating drinking water. Chemicals, such as pesticides and nutrients, often bind to sediment particles.

Soil erosion is the main source of sediment in water. Some soil is eroded naturally through weathering processes of rain and wind. But the main causes of soil loss are agricultural practices, timber harvesting, road and building site construction, and mining activities.

Timber management (road construction, timber harvest, and slash disposal) and other ground-disturbing activities can affect sediment levels in district streams by increasing the capacity of the streams to entrain and transport sediment and by increasing the supply of sediment available for transport. Forestry related sediment problems can be reduced by carefully constructing logging roads and stream crossings, installing culverts to carry runoff, and providing wide set-backs (buffer zones) from streams when timber is harvested.

Construction and mining activities typically disturb large tracts of land, which contribute to sediment problems.

Instream sediment levels are both transport (flow) and supply dependent. Paustian and Beschta (1979), VanSickle and Beschta (1983) and Jackson and Beschta (1982) described bedload transport in terms of supply of material available for transport at various levels of flow; they found that most bedload transport occurred during short periods of high water, when flows were sufficient to entrain coarse, armoring riffle sediments, and access supplies of finer material within

the riffle. Subsequent studies (Jackson and Beschta 1984) have demonstrated that increased amounts of sand in transport can cause previously stable, coarse riffle sediments to undergo scour.

These data reveal that the effects of management activities on sediment transport are directly related to the effects on high flow events. The result of increased high flow events would be increased sediment concentrations and more frequent episodes of riffle scour and fill.

The effect of management activities on the supply of sediment available for transport depends on the average slope of the contributing area and the type of erosion processes dominant in the area of the activity. On gently sloping topography with competent bedrock, little if any increased erosion would be expected (Fredriksen and Harr 1979). On steeper slopes, surface erosion (known as dry ravel) occurs, especially after slash burning. It is not known how much of this eroded material reaches streams and becomes sediment. In areas where debris avalanching is the dominant erosion process, clearcutting has increased the natural rate of avalanching two to four times, and road building can increase the natural rate of erosion as much as 25 to 340 times (Fredriksen and Harr 1979). They also reported that mean-annual suspended sediment concentration in a clearcut watershed, without roads, was about nine times the natural concentration (in an undisturbed forest), and mean-annual sediment concentration in a patchcut watershed, with roads, was about 23 times the natural concentration.

Roads sometimes contribute to increased sediment concentrations because of erosion from the road surface, cut slopes, and fill material. Road construction can increase erosion as much as 250 times in the first storms after construction, but concentrations usually drop off within a few months to two years (Brown 1983). More extended periods of sediment increase may be associated with heavy truck road use during very wet weather, on poorly surfaced roads, or with unauthorized off-road vehicles (ORV) use. Compacted soils (from roads, skid trails, or heavy equipment use) can cause gully erosion and locally large increases of sediment.

Nutrients

Nutrients enter water mainly from treated municipal sewage discharges, failing septic tank systems, and from fertilizers washed into the water by rain or irrigation. Excessive amounts of nutrients released into slow moving waters during spring and summer can result in growths of algae and aquatic weeds. Algae blooms reduce the amount of oxygen available to fish, which can result in fish kills.

To address this problem of algae growth, the Oregon Environmental Quality Commission (EQC) adopted a chlorophyll standard. The amount of chlorophyll in water indicates the amount of aquatic plant growth. Waters violating this standard will be studied to determine the nutrient sources and options for controlling the problem. Maintaining or restoring the quality of the Roseburg District's more heavily used lakes is also an important issue. Lakes undergo a natural aging process which can be accelerated by human activities. Improper agricultural, forestry, and other land use practices cause soil erosion which can introduce sediment and nutrients into the lake.

Sediment from soil erosion can rapidly fill a lake or reservoir, while nutrients increase the frequency of algal blooms and accelerate aquatic weed growth.

Shallow, nutrient-rich lakes often have impaired recreational and aesthetic values. This is especially true for lakes that are "old" in their stage of development; which means they have high nutrient levels and are naturally more marshlike.

Timber Harvest and Slash Disposal

Timber harvest and slash disposal can affect the chemical quality of surface water. In one Oregon Cascades watershed following slash burning instream concentrations of ammonia-nitrogen and manganese reached peak levels of 7.6 and 0.44 mg/l respectively (Fredriksen 1971). Fredriksen attributed the high concentrations of ammonia-nitrogen and manganese to burned slash in stream channels.

The aerial application of herbicides is another management activity that can affect the chemical water quality of streams in the district. A detailed discussion of potential water quality impacts of herbicides proposed for use by the BLM is beyond the scope of this analysis, but the reader is referred to the Final Environmental Impact Statement (FEIS) for the Western Oregon Program for the Management of Competing Vegetation (USDI, BLM, OSO 1989).

Application of nitrogen fertilizers also affects the chemical water quality of streams in the district. Nitrogen is usually added to the soil by aerial application of urea pellets. Since direct fertilizer application is the major pathway for urea entry to streams, urea concentrations usually peak within one to two days

following fertilizer treatment. Ammonia nitrogen, a hydrolysis product of urea, also usually peaks shortly after treatment, since it is derived from urea entering the stream.

Ammonia nitrogen in the soil is held very tightly. Only nitrate nitrogen is readily leached from the soil, and this usually occurs after the ammonia is oxidized to nitrate during the warm growing season. For this reason, peak nitrate concentrations are often recorded one to two years after fertilization. On the other hand, if nitrogen fertilizer is applied shortly after an area has burned, the warm soil temperatures may enhance nitrification and subsequent leaching of nitrate to the stream. Moore (1975) summarized several water quality monitoring studies of forest fertilization with urea throughout the Pacific Northwest and found maximum recorded nitrate values were usually less than one mg/l and in all cases were less than 5 mg/l.

Stream Categorization

Streams are characterized by their "order" (Strahler 1957). Headwater stream channels are designated first order; two first order streams combine to form a second order stream. Two second order streams combine to form a third order, and so forth.

In western Oregon, first and second order streams constitute 79 percent of the total stream mileage (Boehne and House 1983). Such streams rise in very small watersheds with limited water storage capacity. These streams may have only scanty or intermittent flow during the dry season, but during high flows they may move large amounts of sediment and woody debris. Headwater streams mainly determine the type and quality of downstream fish habitat.

First and second order streams are influenced by the geomorphology, soils, and vegetation of their channels. Large woody debris is common, covering as much as 50 percent of the channel (Anderson and Sedell 1979, Swanson and Lienkaemper 1978, Triska and others 1982). The stream is continuously shaded by vegetation. Flow energy in the channel is continually dissipated by woody material and vegetation that slow erosion and foster deposition of organic and inorganic materials. The average gradient of these streams often exceeds 10 percent, but the channels usually have a stairstep configuration of flat reaches connected by riffles and low falls. Salmonid reproduction may be sufficient, even in some ephemeral streams, to furnish fry to larger waters downstream (Everest 1973, Everest and others 1985).

Third and fourth order streams usually flow continuously. Average gradient is less than five percent, but there may be intermittent stretches of rapids or falls. Woody debris usually covers less than 25 percent of the channel. High flows may flush woody material from the system or deposit it in debris jams. The vegetative canopy over third and fourth order streams varies in density. These streams can transport large amounts of sediments, which are often deposited around channel obstructions, in narrow, winding areas, or in other areas of low velocity such as accretion bars, estuaries, and the flood plain.

The direct influence of riparian areas is moderated in fifth order and larger streams but remains important. Canopies of large, old-growth trees provide some shade, vegetated riparian zones keep the main channel confined, and the largest stems of down trees that remain in the stream provide important summer and winter salmonid habitat. Flood plains of the larger streams contain complex arrays of side channels, overflow channels, and isolated pools. Side channels are often created and maintained by large woody debris (Bisson and others 1987, Sedell and others 1984). The gradient in large streams is usually less than one percent, but rapids and falls may occur. Alluvial material and woody debris may be deposited in quiet areas, but accumulations are flushed and rearranged during high flows (Sedell et al. 1988).

Riparian Areas

Riparian areas are the green zones along the banks of creeks and rivers and around springs, bogs, wet meadows, lakes, and ponds. In the Roseburg District some riparian areas are characterized by a zone of deciduous trees and shrubs located between the stream and the conifer forest. Others in more xeric sites are largely nondescript with conifers growing to the edge of streams without much deciduous growth.

The BLM defines riparian areas as an area of land directly influenced by permanent water. It has visible vegetation or physical characteristics reflective of permanent water influence. Lake shores and stream banks are typical riparian areas. Excluded are such sites as ephemeral streams or washes that do not exhibit the presence of vegetation dependent upon free water in the soil.

Riparian areas are unique and among the most productive and important ecosystems on lands managed by BLM. They display a greater diversity of plant and wildlife species and vegetation structure than adjoining ecosystems.

As transition zones between terrestrial and aquatic systems, riparian areas influence exchanges of energy and materials between these systems and offer unique habitats attractive to many species (Naiman et al. 1988). Sediments and organic matter moving down slope often accumulate in riparian areas causing them to be sites of high forest productivity. The characteristics of riparian zones influence the composition of aquatic communities and rates of stream ecosystem processes: litter production and shading by streamside vegetation regulates water temperature and light available for in-stream primary production. Conversely, stream erosion and deposition represent disturbances in riparian areas and produce streamside vegetation that is structurally and compositionally complex (Hansen et al. 1988).

Riparian vegetation along upper watershed streams can absorb and dissipate the energy of flood waters before they reach high value agricultural and residential lands in lower valleys.

Many wildlife species are dependent upon the unique and diverse habitat niches offered by riparian areas. These habitats provide food, water, shade, and cover and are valuable sources of forage for big game animals. Riparian vegetation is of critical importance for fish, especially salmonids. The vegetation provides escape cover, lowers summer water temperatures through shading, reduces stream bank erosion that can silt in spawning and rearing areas, and provides food material for insects, which are in turn a food source for fish. Riparian areas are also focal points for recreation, including fishing, camping, boating, swimming, hiking and simple relaxation.

Healthy riparian systems purify water as it moves through the vegetation by removing sediment, and providing sponge-like water retention in streambanks and groundwater aquifers.

More recently, the role of riparian forests as filters for nutrients has gained recognition, particularly in connection with agricultural operations. Studies in Maryland and France indicate a 10-fold decrease in nutrient concentrations as well as sediment load across riparian forests. Part of the decrease in nutrients is attributable to uptake by trees, which are important sinks for nitrogen and phosphorus. Bacterial denitrification is another important sink for nitrogen. Soils that are frequently saturated and high in organic matter, such as those often found in riparian forests, are conductive to denitrification (Ice 1990).

Streamside vegetation affects nutrient loss from basins both directly through root uptake and indirectly via influences on aquatic plants and inputs of woody debris and leaves. Riparian vegetation can remove more than 75 percent of the nitrogen moving from upslope down into stream channels. More than 90 percent of added nitrogen can be removed within 300 m in streams with complex flood plains. Canyon reaches in the same streams removed less than 25 percent of added nitrogen.

In a first order watershed in the Cascade Mountains, more than 50 percent of the nitrogen entering the stream in groundwater was removed before leaving the watershed. Streams and floodplains have a high potential to retain both particulate and dissolved nutrients (Gregory 1989).

Riparian areas may support greater annual growth rates for individual trees on favorable growing sites, but this may be negated by higher mortality in the streamside environment and the abundance of locally unsuitable growing sites.

Two recent studies found that riparian forests contained lower abundances of conifers in stream side forests than in adjacent upslope forests. In four stands that were older than 90 years, the total conifer basal area was 65 percent of that estimated for the upslope forests (Andrus and Froehlich, 1988). Conifers in riparian areas need to reach 150 - 200 years of age in order for streams to reach maximum production potential regarding bio-mass, bio-diversity and species richness (G. Reeves personal communication).

Because riparian forests may support lower timber volumes, the proportion of total forest timber volume contained in riparian management zones may be less than acreage alone would indicate. In most western Oregon forests, riparian areas comprise well less than 10 percent of the general forest, but provide numerous resource values for water quality, fisheries, and wildlife (Gregory and Beschta et al 1990). Although riparian forests may have lower volumes of trees than upslopes, riparian plant communities are still ecologically important not only for fish and wildlife but also for terrestrial plant communities. The study of riparian plant communities in the McKenzie River drainage found that the number of terrestrial plant species in riparian areas is more than twice that of upslope forests (Gregory and Beschta et al 1990). With changing land use and climate, the rich pool of species in riparian forests may be a critical resource for maintaining the diversity of terrestrial plant communities over the forest as a whole.

The economic benefits of retaining conifers in riparian zones as habitat for anadromous fish was compared to maximum timber production in a western Oregon study. The benefits of maintaining the conifers so they contributed to large woody debris in the stream was

calculated to be 11 percent greater by year 20 and 59 percent higher after 94 years (an increase of over $100,000 at present value) over conifer stumpage in the riparian zone (House and Crispin 1990).

More important to resource management, however, is the ecological rational for a protective vegetation zone along streams and rivers of all sizes. Streamside vegetation zones are justified on the grounds of stream temperature control, stream bank stabilization, water quality protection and food resources. Streamside vegetation is also the primary supplier of large organic debris-snags or tree stems eight inches in diameter with root wads attached or tree branches more than eight inches in diameter.

Erosion may contribute debris to streams and account for water transporting pieces of debris. Organic debris in streams increases aquatic habitat diversity by forming pools and protected backwater areas, provides nutrients and substrate for biological activity, dissipates energy for flowing water, and traps sediment (Maser, Tarrant, Trappe and Franklin).

First and second order streams feed third and fourth order streams with partially used food, the amount of which becomes progressively smaller as stream order increases. Small streams derive much food for invertebrates from wood or leaf litter under old-growth forests. The forest influence diminishes as streams become progressively larger and the stream energy base comes more from algae and less from forest litter. The forest influence is greatest in very small streams, but most diverse organic input mechanisms and habitats are in third to fifth order streams.

Geomorphic and Hydrologic Function

Stream riparian areas have important geomorphic and hydrologic roles that support their high level of biological productivity. The most productive stream riparian areas are often associated with alluvial stream systems. That is, they are deposition zones and occur in fluvial sediments transported and re-worked by the stream. A major role of the riparian area is to function as a flood plain and dissipate stream energies associated with high flows. This, in turn, permits sediments to deposit and continue development of the alluvial valley floor.

Alluvial riparian areas also function as shallow aquifers that recharge at high flows and drain at low flows. This interaction between surface flows and ground water storage results in moderated high flows and enhanced or prolonged base flows. The shallow aquifer condition also creates the moist soil conditions required for plant growth, which characterize riparian areas.

Thus, it is the geomorphic and hydrologic characteristics of riparian areas that establish the basic components of biological habitat, including wet soils and in-stream structural features such as pools, riffles, gravel and stream banks. The vegetation that thrives in riparian areas, in turn, contributes to their proper geomorphic and hydrologic functioning. Disruption of normal geomorphic or hydrologic function, or the vegetation on which it depends, usually results in impairment of overall riparian resource values.

Geomorphic structure, such as pools and flood plains, strongly influence stream and riparian ecosystems. This is particularly true in steep, mountain valley floors typical of the coast range and west slope of the Cascades where floods and debris flows can damage riparian vegetation and alter aquatic habitat on a frequency of years to decades.

The frequency and extent of disturbance, accessibility of riparian areas for wildlife, and magnitude of vegetation influence on stream ecosystems, varies as a function of drainage area and the associated variables of stream channel and valley floor widths. Another important source of structural variability along streams is exogenous (non-fluvial) factors such as bedrock outcrops and large hillslope landslides. Areas of very narrow valley floors can occur along headwater channels in V-shaped valleys or in bedrock or landslide controlled gorges along larger channels. Such areas may have extensive topographic shading, little opportunity for resetting of riparian vegetation by floods, little riparian habitat, and the environmental gradients for terrestrial wildlife are abrupt. In wider valley floors, on the other hand, channels can move laterally, creating complex mosaics of vegetation and secondary channels which are rich aquatic and terrestrial habitat. If only fluvial processes have formed valley floor landforms and there has been no significant influence of variation in bedrock hardness, hillslope landslides, and other exogenous factors, valley floor and channel widths are likely to increase uniformly in the downstream direction. Channel and valley floor conditions may vary greatly from one geologic terrain to another (Hansen et al 1988).

A buffer zone of 2.5 to 3 tree heights (approximately 400-500 feet) is required to protect streamside riparian zones from changes in microclimate and wind damage that can threaten the integrity of vegetative structure and species composition. (Personnel communication Franklin, J.F. and Reeves, G.). Microclimate impacts to riparian zones include not only increased water temperature caused by solar radiation, but higher water temperatures due to elevated air temperature-water surface contact. Convection water temperature increases of up to 20°F have been documented in

western Oregon (Leuno and Rothacher 1967). Another microclimate change is caused by reduced humidity which can cause compositional changes in vegetative species. This can alter allochtonous sources for a food chain based on decaying leaves and benthic invertebrates. This has potential impacts to fisheries.

Subterranean invertebrates thrive in a maze of underground channels that flow among the gravel, sands and rock that underlie many streams and rivers. These underground waterways can be as deep as 30 feet and can extend sideways for miles from the stream channel.

In this understream area called the hyporheic zone many types of small blind shrimp, primitive worms, bacteria, algae and various kinds of immature insects live. These underground animals support a food chain that extends to the surface. The hyporheic zone serves as a refuge for creatures during times of drought or stress; and after floods streams may rely on the life underground to assist in repopulation of aquatic invertebrates. The underground system is rich in bacteria that fix nitrogen, which is in great demand by surface organisms.

Timber management activities (road construction, timber harvest and slash disposal) remove riparian vegetation, constrain natural stream channels and alter stream banks and channel structure at stream crossings.

Debris torrents, often caused by clearcut timber harvesting techniques and/or road construction in very steep terrain, scour stream beds down to bedrock, damage riparian vegetation, and eliminate the ability of riparian areas to store water and function as shallow aquifers. While harvesting timber, it is sometimes necessary to yard logs through riparian areas; this can cause damage to riparian vegetation and stream banks.

Groundwater

Water which infiltrates the soil surface is known as groundwater. Most groundwater eventually discharges into stream channels. Groundwater is found in layers called aquifers, water bearing rocks or sediments which occur at depths from a few feet to several hundred feet below the surface. There are two types of aquifers; unconfined and confined. Unconfined aquifers are also known as water table aquifers. Unconfined aquifers are generally shallow with an impermeable layer of rock or soil defining the lower boundary and the water table (saturated zone) located between the impermeable layer and land surface. These shallow, unconfined aquifers are prone to contamination from surface pollutants. Confined aquifers (also known as artesian aquifers) are very deep below the soil surface and are separated from the surface by an impermeable layer of rock or soil. The quality of water in confined aquifers is generally excellent, however in some cases, chemicals in the subsurface geologic formations can add undesirable contaminants, such as arsenic boron or sodium.

Groundwater is replenished by rain and snow which filters through soil and geologic formations. This underground water generally moves slowly from mountains and uplands to low lands and valleys, where it is discharged to creeks, rivers, and marshes. Groundwater discharges to surface waters provide the base flow for streams throughout Oregon. This discharge may vary significantly in different areas, depending on the nature of the aquifer.

Water tables generally rise after removal of vegetation due to increased water (from reduced transpiration) recharging groundwater areas. However, reductions in groundwater may occur when subsurface flow is intercepted by road cuts and transformed into surface water through a ditch-culvert system. Some of this water is deposited on undisturbed soil areas where it returns to subsurface flow. The remainder is deposited into channels where it becomes streamflow.

Appendix 3-4
1988 Water Quality Status Assessment Report - Umpqua Basin.

Percent	Type	Description
1.6	Irrigated agriculture	Land improved by artificial application of water through irrigation.
1.6	Non-Irrigated agriculture	Land cultivated and/or harvested without benefit of irrigation
5.7	Range	Includes areas characterized by grasses, shrubs, meadows and unimproved pasture.
89.3	Forest	Land primarily occupied by, or used to produce trees - both deciduous and conifer.
0.5	Urban	Residential, commercial, industrial, and other urban developments.
0.2	Water	Natural and man-made waterways and impoundments measurable at mapped scale.
1.1	Other	Includes highway interchanges, marshes, snow-ice-feed lots, quarried, etc.

Appendix 3-5
Oregon State Department of Environmental Quality Non-Point Source Pollution Assessment Report

Appendix 3-5. Oregon State Department of Environmental Quality Non-Point Source Pollution Assessment Report

Segment Number		Turb	Low-Do	Temp	Nutr	Pest	B/V	Gases	Solid	Sed	Eros	Lowflo	Debris	Struct	Plants	Other	Impairment Rating
Upper Smith River																	
1	Smith River			M1						M2				S1			A1
12	Halfway Creek													M2			B
Elk Creek																	
14	Umpqua River			S2								M2					A1
23	Elk Creek			S2						N2	N2	M1		M2			A1
24	Big Tom Folley Creek			M2						M2				M2			B
25	Billy Creek										M2			M2			B
26	Pass Creek			S2							M2	M2		M2			A1
27	Rock Creek			S2								M2					A1
28	Sand Creek			S2													A1
372	Elk Creek		M2	S2	M2		S2			M2	M2	M1					A1
373	Elk Creek		S1	S2	M1		S1			M2	M2	M1				M1	A1
Upper Umpqua																	
30	Wolf Creek			M1						M1	M2			M2			B
31	Hubbard Creek			M1						M1		M1					B
Calapooya																	
32	Calapooya Creek			S2			M1			M2	M2	S1		M2			A1
33	Calapooya Creek			M2			M1			M2	M2	M1		M2			B
34	Calapooya Creek	M2		M2						M2	M2			M2			B
35	Coon Creek											S2					A1
36	Dodge Canyon Creek			M2						M2	M2	S2		M2			A1
37	Williams Creek			M2						M2	M2	S2		M2			A1
38	Pollock Creek			S2								S2					A1
39	Bachelor Creek		S2	S2								M1					B

Appendix 3-5. Oregon State Department of Environmental Quality Non-Point Source Pollution Assessment Report (cont.)

Segment Number		Turb	Low-Do	Temp	Nutr	Pest	B/V	Gases	Solid	Sed	Eros	Lowflo	Debris	Struct	Plants	Other	Impairment Rating
Calapooya (cont.)																	
40	Oldham Creek			S2								S2					A1
14	Umpqua River			S2								M2					A1
371	Umpqua River			S2	M1		M1					M2					A1
Rock Creek																	
49	Rock Creek	M2		M2					M2	M2							B
Canton Creek																	
51	Canton Creek	M2		M1						M2				S1			A2
Little River																	
46	Little River	M2		M2						M2	M2	M2		M2			B
47	Fall Creek									M1							B
48	Cavitt Creek	M1		M2						M1	M2		M2	M1			B
417	Jim Creek									M2							B
Lower North Umpqua																	
41	North Umpqua River			S1						M2	M2						A2
43	Sutherlin Creek											S2					A1
44	Cooper Creek											S1					A1
46	Little River	M2		M2						M2	M2	M2		M2			A1
South Umpqua/Roseburg																	
66	South Umpqua River	S2	S1	S1	S1		S1	M3	M2	S2		S1			S1S1	Water Quality	
68	Deer Creek	S2		S2	M2		S2	M3		S2	S2	S1				Limited.	
69	Deer Creek	S2								S2	S2	S1				TMDLS	
69	Deer Creek North Fork	S2								S2	S2	S1				Required	
69	Deer Creek South Fork	S2								S2	S2	S1					
114	Clark Branch											S2					

Appendix 3-5. Oregon State Department of Environmental Quality Non-Point Source Pollution Assessment Report (cont.)

Segment Number		Turb	Low-Do	Temp	Nutr	Pest	B/V	Gases	Solid	Sed	Eros	Lowflo	Debris	Struct	Plants	Other	Impairment Rating
South Umpqua/Roseburg (cont.)																	
115	Roberts Creek											S1					
116	Champagne Creek											S1					
370	South Umpqua River	S2		S1	M2		M1	M3	M2	M1		M1		M2	M2		
Myrtle Creek																	
77	Myrtle Creek	M2		S1							M2	M1					
77	North Myrtle Creek	M2		S1							M2	M1					
78	North Myrtle Creek			M2						S2	M2	M1					
82	South Myrtle Creek	M2		S2						M2	M2	M1					
83	South Myrtle Creek			M2						M2		M1					
370	South Umpqua River	S2		S1	M2	M1	M3	M2	M1		M1		M2	M2			
Olalla/Lookingglass																	
70	Lookingglass Creek	S2															
71	Lookingglass Creek											S1					
72	Olalla Creek	S2															
73	Olalla Creek	M2								M2							
74	Olalla Creek											S1					A1
75	Tenmile Creek											S1					A1
76	Byron Creek											S2					A1
111	Rice Creek											S2					A1
112	Kent Creek											S2					A1
113	Willis Creek											S2					A1
402	Thompson Creek			M2		M3				M2	M2	M2					B

Appendix 3-5. Oregon State Department of Environmental Quality Non-Point Source Pollution Assessment Report (cont.)

Segment Number		Turb	Low-Do	Temp	Nutr	Pest	B/V	Gases	Solid	Sed	Eros	Lowflo	Debris	Struct	Plants	Other	Impairment Rating
Cow Creek																	
67	South Umpqua River			S1						M1		S1		M2			A2
91	Cow Creek	M2		M2	M3				M3								A2
99	Middle Creek	M2		M2							M2						B
108	Ash Creek											S2					A1
370	South Umpqua River	S2		S1	M2		M1	M3	M2	M1		M1		M2	M2		A2
Lower South Umpqua																	
67	South Umpqua River			S1						M1		S1		M2			A2
109	Canyon Creek											M1					B
110	O'Shea Creek											M1					B
Upper South Umpqua																	
67	South Umpqua River			S1						M1		S1		M2			A2
84	Days Creek	M2		S2							M2	S2			M2		A1
85	Days Creek			M2								S2					A1
86	Stouts Creek	M3		M3						M3							B
124	Deadman Creek			M1										M1			B
423	Coffee Creek	S1								S1							A1
Middle Fork Coquille																	
169*	MF Coquille River	M2			M2					M2	M2			M2			B
170	MF Coquille River									M2							
199	Twelve Mile Creek									M2							
200	Bridge Creek																
201	Boulder Creek																
202	Dice Creek																

Turb	Turbidity
Low-Do	Low Dissolved Oxygen
Temp	Elevated or Depressed Water
Nutr	Nutrients
Pest	Pesticides
Toxic	Toxics
Salt	Sale Water Intrusion
B/V	Bacteria/Viruses
Radio	Radioisotopes
Gases	Dissolved Gases
Solid	Objectionable Discoloration, Scum, Oily Slick or Film, Floating Solids
Sed	Sedimentation
Eros	Streambank Erosion
Lowflow	Decreased streamflow
Debris	Excessive Debris Accumulation
Struct	Insufficient Stream Structure
Plants	Excessive Plant Growths
Other	Other (specified in comments)

S1 = Severe problem, data
S2 = Severe problem, observation
S3 = Severe problem, perception
M1 = Moderate problem, data
M2 = Moderate problem, observation
M3 = Moderate problem, perception

*This stream segment is on Coos Bay BLM District.

Appendix 3-6
Watershed Condition Index Methodology

Introduction

Watershed condition index: The watershed condition index (WCI) is a method of rating the physiographic conditions (e.g., soil type) and land management activities (e.g., road building) which have some effect on the hydrological functions of watersheds. The index represents conditions on whole Analytical Watersheds, including BLM, private and other agency lands. Therefore, the index is an indicator of the cumulative effects of all management activities, private and public.

The purpose of the WCI in this RMP is to compare the current condition (as of October 1, 1988) in a selected analytical watershed, with future conditions anticipated under each of the seven land management alternatives in the RMP. For purpose of analysis two assumptions are made:

- future BLM management activities described in the alternatives would occur during the last five years of the 10-year planning period once the RMP is implemented;
- fifty percent of all private harvestable timber, identified on BLM's Gross Vegetation GIS theme as Heavy Timber, would be cut during this planning decade (unless more detailed information is known regarding timber harvest on private lands.

Guidance for assessing conditions and calculating the individual indexes is summarized in the pages to follow.

The individual indexes are comprised of rating elements, which are mathematically combined in formulas and adjusted using a constant (X) to give a rating between 1 and 2 under an AWS's existing condition. These constants are developed individually for AWSs on each district. A rating of 1 implies watershed condition is minimally affected and 2 implies watershed condition is highly affected. Ratings in the mid-range are considered to have a moderate effect. Some ratings will exceed 2 under some alternatives. The numeric value has no meaning by itself. Each rating element in a formula is assigned a multiplier which reflects the relative impact of each element on the watershed condition. For example, a paved road has less impact on watershed condition than a dirt road. The paved road is given a low weighting, and the dirt road is given a high weighting. These weightings are based on the professional knowledge and judgment of district soil scientists and hydrologists.

The WCIs are gross indicators of current and future watershed conditions. Differences in watershed condition due to individual activities will be analyzed during project planning in the respective environmental assessments.

The formula for calculating the watershed condition indexes is:

$$WCI=SDI*VI*SI*RI*MI*KI*AI*DI*PI*FI*LI$$

WCI = watershed condition index
SDI = soil disturbance index
VI = vegetation index
SI = silvicultural index
RI = riparian index
MI = mining index
KI = soils index
AI = slope/aspect index
DI = drainage density index
PI = precipitation index
FI = flow index
LI = landslide index

The product of all rating indexes is the watershed condition index.

Individual Index Calculations

Soil Disturbance Rating Method: Soil disturbance was rated by calculating the acres of roads (by surface type), skid trails, and other areas of soil disturbance. The data were collected through a photo inventory of the selected analytical watersheds and through WODDB (GIS) records. The formula for the soil disturbance index (SDI) is:

$$SDI=1+[(P+3R+6)+1.571(14T+5C)/W]$$

Where:

P=paved roads (acres)

R=rocked roads (acres)
D=dirt roads (acres)
T=skid trails/Tractor logging (acres)
C=cable logging/high lead (acres)
W=watershed size (acres in District inventory)

Vegetation Type Rating Method: Each vegetation type was given a weighting based on its effect on watershed condition and water quality. The acreage of each current vegetation type was estimated through a photo inventory of the selected analytical watersheds. The acres assigned to the age class of partially cut lands were calculated as the area cut multiplied by the percent of volume cut. The formula used to calculate the vegetation index (VI) is:

$$VI=1+[(6G+3BR+3D+10CC+5S+3RP+P+7A)*X/W]$$

Where:

VI=vegetation index
G=meadow/grass (acres)
BR=pasture or permanent brush (acres)
D=disturbed (>20% bare soil) (acres)
CC=clearcut (0-3 years)
S=forest (4-8 years)
RP=forest 9-12 years)
P=forest 13-20 years (acres)
W=watershed size (acres)
A=area to be harvested in the10-year period (acres) by alternative
X=constant (.42)

Silvicultural Practices Rating Method: Five silvicultural practices that can affect water quality and watershed condition have been identified through a photo inventory of the selected analytical watersheds and from resource area silviculturists knowledge and records. The formula used to calculate the silvicultural index (SI) is:

$$SI=1+[(10T+5B+3H+2F+P)/W*X]$$

Where:

T=tractor piling (acres piled in the past 20 years)
B=burning (acres burned in the past 1-2 years)
H=herbicides (acres treated with herbicides in the past year)
P=PCT (acres thinned in the past 5 years)
W=watershed size (acres) X=constant (.75)

Riparian Rating Method: Riparian conditions were classified through a photo inventory of the selected analytical watersheds. Total acres of each riparian type were projected from total riparian acres by stream order identified in WODDB. The formula used to calculate the riparian index (RI) is:

$$RI=1+[(8S+5P+3T+L)/R*X]$$

Where:

S=seedlings or saplings
P=pole timber
T=small saw timber
L=large saw timber
R=total acres of riparian zones X=constant (.125)

Mining Rating Method: Mining was rated by the number of operation notices for placer and sand and gravel mining. Only existing notices were considered unless future plans were known. The formula used to calculate the mining index (MI) is:

$$MI=1+[(N/M)*X]$$

Where:

N=number of notices
M=miles of stream
X=constant (8)

Soils Rating Method: Soils were rated by using the K factor from the Universal Soil Loss Equation. The formula used to calculate the soils index (KI) is:

$$KI = 1+[(S1xK1+S2xK2...)/W*X]$$

Where:

S1, S2=acres of each soil series in the watershed
K1, K2=k numbers W=watershed size (acres)
X=constant (3.5)

Slope-Aspect Rating Method: Slopes were calculated using GIS and the USGS digitized topography map at a scale of 1:250,000. By using the topography map at this scale, those areas with long slopes and substantial changes in elevation were identified. Critical aspects were identified through the TPCC mapping of BLM-administered lands with excessively steep, nonsuitable woodlands. The TPCC category included in the critical aspect factor was FGR* (generally steep, fragile slopes). The formula used to calculate slope index (AI) is:

$$AI = 1+[((S/W)+(A/WB))*X]$$

Where:

S=area > 60 percent slope (acres)
A=area of critical slopes (FGR)
W=watershed size (acres)
WB=BLM ownership within watershed (acres)
X=constant (4.35)

Drainage Density Rating Method: Drainage density was calculated using the National Handbook of Recommended Methods for Water Data Acquisition. The formula used to calculate the drainage density index (DI) is:

$$DI = 1+(DD*X)$$

DD=drainage density
X=constant (.08)

Precipitation Rating Method: Two-year, 24-hour precipitation amounts were used to calculate the precipitation index. The formula used to calculate the precipitation index (PI) is:

$$PI = 1+(P*X)$$

Where:

P=precipitation from the average 2-year, 24-hour storm in the watershed.
X=constant (.125)

Flow Rating Method: Flow was obtained by using the USGS method of predicting a 2-year flood, measured in cubic feet per second per square mile (cfs/sq. mi.). The formula used to calculate the flow index (FI) is:

$$FI = 1+(Q*X)$$

Where:

Q=two-year flood (cfs/sq. mi.)
X=constant (.00525)

Landslide Rating Method: Slope stability was determined by rating each soil series as stable or unstable. The stability index is calculated from the percent of the basin that is unstable. The LI formula is:

$$LI=1+[((W-U)+(U*9))/W*X]$$

Where:

U=area of unstable soils (acres)
W=watershed size (acres)
X=constant (.1)

Current Watershed Condition

The current watershed conditions for the selected analytical watersheds, as determined through the use of the WCI are in the main body of Chapter 3 (existing) and compared to those in Chapter 4 (by impact per alternative). The WCI's individual indices serve as indicators of potential management problems and opportunities within watersheds.

Impacts Under Various Alternatives

A ten year representative timber management scenario was used in the analysis of impacts of the alternatives. (See Chapter 4 Introduction.)

Ten year scenarios were extracted in the GIS and overlain by Analytical Watersheds to ascertain possibile locations of harvest units and roads in an AWS by alternative. The following are changes in the WCI from existing condition to those anticipated under various alternatives:

Soil Disturbance Index: For the ten year scenarios, existing acres of the various types on the WCI are decreased by a recovery factor of 1.25 percent per year, or 12.5 percent total reduction for the ten year scenario (this is based on the 80-year recovery model our cumulative impacts analysis utilizes). No recovery for roads is included. The equivalent harvest acres are then added, along with estimated non-BLM harvest and probable yarding method. This provides the estimated SDI harvest impacts after 10 years. The acres of existing condition (minus 10-year recovery) and the non-BLM harvest acres remain constant across all alternatives; only equivalent acres of proposed harvest and proposed roads would vary.

Vegetation Index: On the vegetation index, acres of grass, brush, and disturbed areas were held constant on all alternatives. The following assumptions were also made:

- assumed five year lapse between harvest and replanting;
- BLM has five years from sale date to replant, so figured replanting would occur two to three years after actual harvest. We are assuming all BLM harvest would occur in the last five years of the decade, so in 2001, all BLM harvest would still be in the 0- 3 age class;
- Assumed private harvest would occur at a steady rate all ten years.

Under these assumptions, new harvests entering the 0-3 age class would remain in that class for approximately eight years (five years at age 0, plus three more years to move into the 4-8 age class). This averages to 1/8 of the total 0-3 moving into the 4-8 class each year. Under these assumptions, today's 0-3 age class would be distributed as follows in ten years:

AGE CLASS	PERCENT
4-8	37.5 %
9-12	50.0 %
13-20	12.5 %

Existing 4-8 in ten years would be

13-20	100.0 %

Existing 9-12 in ten years would be

13-20	50.0 %

All existing 13-20 would be >20 in ten years. These are the formulae Roseburg District is using for the ten year scenario forest age classes:

0-3 = (acres of projected ten year private harvest * 0.82)+(BLM 10 year scenario equivalent harvest acres totalled)

4-8 = (projected ten year private harvest * 0.18)+(existing 1988 age 0-3 * .375)

9-12 = (existing 1988 age 0-3 * 0.5)

13-20 = (existing 1988 age 0-3*0.125)+(existing 1988 age 4-8)+ (existing 1988 age 9-12*0.5)

Riparian index: The alternative A buffer widths will be used in calculating the total riparian acres for both BLM and non-BLM. Harvest-induced riparian impacts were calculated using the following information:

total BLM acres
total non-BLM acres
BLM stream miles by order
non-BLM stream miles by order
BLM RTU (proposed ten year scenario) acres by alternative
Estimated acres of private to be harvested

• Take BLM and private stream miles by order/total BLM and private acres to obtain factors for stream miles by order per acre of BLM and private in an AWS;

• Multiply RTU equivalent harvest acres * each stream order factor to obtain the estimate of stream miles by order which would be adjacent to RTUs (0.8 or 80 percent of order 1 streams' riparian removed and full protection elsewhere on BLM) and non-BLM lands (100 percent on orders 1-3 and 80 percent on order 4 and larger);

• Convert these lengths to acres based on the buffer width for the alternative being analyzed, but only for those orders on which in-buffer harvests would occur;

• Integrate these calculations with existing condition to ascertain impacts of these calculated changes upon the existing condition over the next ten years (for a better understanding of Riparian Rating see :

Rating 1 (seedling/sapling)

(Equivalent acres of new riparian harvest)+(existing 1988 rating 1 acres * .667)

Rating 2 (pole)

(existing 1988 rating 1 acres * .333) + (existing 1988 rating 2 acres * .667)

Rating 3 (small saw)

(existing 1988 rating 2 acres * .333) + (existing 1988 rating 3 acres * .875)

Rating 4 (large saw and older)

(existing 1988 rating 4 acres) + (existing 1988 rating 3 acres * .125) - (equivalent acres of new riparian harvest)

* All other subindices in the WCI were assumed to remain constant throughout the RMP.

Appendix 3-7
Stream Habitat Quality Rating

The rationale for using riparian tree size (dbh) to rate stream habitat quality is based on research (Sedell et al 1988), inventory data, and field experience of BLM fishery biologists. Data from these sources indicate that vegetative conditions (size of trees) in adjacent riparian areas are directly related to stream habitat quality and fish populations. Trees in riparian areas fall into streams and create desirable habitat conditions. Tree size information is available in the BLM Operations Inventory and was used for making the initial stream habitat quality rating.

A "related factors" analysis was done to determine if other factors should be considered in making a final habitat quality rating. There are many interrelated physical and biological factors that affect the quality of fish habitat and fish populations. In addition to tree size in riparian areas, other factors include amount of water diversion, amount of sediment yield, availability of natural structure, presence of beaver dams or side channels, presence of rehabilitation structures, or presence of roads in the riparian area. Some of these factors are not inventoried for all BLM stream segments. Therefore, the district biologist determined which of the known factors were most important in making a final habitat rating.

Using the initial rating based on tree size and the related factors analysis, conditions of all streams were rated as minimal, fair, or good/optimal. Initial ratings were "downgraded" on some stream miles and upgraded on others. (i.e., some fair ratings went to minimal and some good/optimal went to fair).

The characteristics of the condition classes are as follows:

1. **Minimal.** Major alterations in watershed or water quality and quantity conditions, natural stream habitat and riparian areas; few or no large trees present in riparian areas with most 0-11" dbh; little or no large woody debris; pools few and shallow; heavy sedimentation of streambed by sand and silt; stream productivity for aquatic life drastically reduced, fish populations at only 10-25 percent of potential.

2. **Fair.** Watershed moderately impacted by activities; riparian vegetation altered by past events or activities, few large trees present with most 11-21" dbh; physical stream conditions substantially altered from natural conditions because of past or present activities, e.g., limited amount of large woody debris and fine sediments in pools and riffles above natural amounts; some adverse changes in water quality and quantity; habitat either partly recovered or still decreasing in trend; stream moderately productive for aquatic life, but fish populations far below potential (approximately 50 percent).

3. **Good/Optimal.** Watershed either not greatly impacted by activities or mostly recovered and in good condition; riparian areas in good condition with diverse vegetation including large trees over 21" dbh; physical stream conditions only slightly altered with nearly complete recovery or virtually unchanged from natural conditions, e.g., abundant and diverse instream structure including large woody debris, numerous deep pools, bottom substrate relatively free from fine sediments, adequate spawning gravels, and stable banks and channels; water quality and quantity (temperature, turbidity, flow, etc.) generally unaltered from natural conditions; stream highly productive for aquatic life, i.e., producing near or at its potential for salmon, trout, and other native fishes.

Appendix 3-8
Wildlife Species and Primary Habitat Affinities in the Roseburg District

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
AMPHIBIANS											
Northwestern Salamander		X			X	X	X			X	
Western Long-toed Salamander		X	X	X						X	
Pacific Giant Salamander				X	X	X	X				X
Olympic Salamander					X	X	X	X			X
Clouded Salamander	A	X	X	X							
Oregon Slender Salamander	A			X		X					
Ensatina		X	X								
Dunn's Salamander				X	X	X	X	X			X
Del Norte Salamander	Cat 2			X	X	X		X			
Western Redbacked Salamander		X	X	X	X	X	X	X		X	X
Roughskinned Newt		X	X	X	X	X	X				X
Western Toad		X	X				X			X	
Pacific Tree Frog		X	X	X	X	X	X			X	X
Tailed Frog	A	X	X	X	X	X	X			X	X

Appendix 3-8. **Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)**

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Red-legged Frog	Cat 2						X				X
Foothill Yellow-legged Frog	Cat 2						X				X
Cascade Frog	Cat 2						X				X
Bullfrog							X				
Spotted Frog	Cat 2	X					X				
REPTILES											
Western Pond Turtle	Cat 2	X	X				X			X	X
Northern Alligator Lizard		X	X							X	
Western Fence Lizard		X	X					X		X	
Western Skink		X	X				X	X		X	X
Southern Alligator Lizard		X	X							X	
Common Kingsnake	A	X					X				
California Mountain Kingsnake	A		X					X		X	
Rubber Boa		X	X							X	
Racer		X									
Sharptailed Snake	A						X	X		X	X

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Pacific Ringneck Snake		X	X				X			X	X
Pacific Gopher Snake							X				X
Western Aquatic Garter Snake							X				X
Western Terrestrial Garter Snake							X			X	X
Mountain Garter Snake							X			X	X
Northwestern Garter Snake		X									
Common Garter Snake							X			X	X
Western Rattlesnake								X		X	
BIRDS											
Common Loon							X				
Pied-billed Grebe							X				
Eared Grebe							X				
Western Grebe							X				
American Bittern							X				
Great Blue Heron					X		X				X
Common Egret					X		X				X

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Green Heron							X				X
Black-crowned Night Heron							X				X
Tundra Swan							X				
White-fronted Goose							X				
Snow Goose											
Ross Goose							X				
Canada Goose							X				
Wood Duck					X	X	X		X		X
Green-winged Teal							X				
Mallard							X				
Northern Pintail							X				
Blue-winged Teal							X				
Cinnamon Teal							X				
Northern Shoveler							X				
Gadwall							X				
American Wigeon							X				
Canvasback							X				

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Redhead							X				
Ring-necked Duck							X				
Greater Scaup							X				
Lesser Scaup							X				
Harlequin Duck	Cat 2			X	X	X	X				
Common Goldeneye							X				
Bufflehead					X	X	X		X		X
Hooded Merganser					X	X	X		X		X
Common Merganser					X	X	X		X		X
Red-breasted Merganser							X				
Ruddy Duck							X				
Turkey Vulture		X						X		X	X
Osprey							X		X		X
White-tailed Kite							X				X
Bald Eagle	T					X	X		X		
Northern Harrier							X				

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Sharp-shinned Hawk				X	X	X					
Cooper's Hawk				X	X	X					X
Northern Goshawk	Cat 2				X	X					
Red-tailed Hawk		X				X					X
Rough-legged Hawk						X					
Golden Eagle		X				X					
American Kestrel		X							X		X
Merlin							X				
Prairie Falcon		X						X			X
Peregrine Falcon	E							X			
Ring-necked Pheasant							X				
Blue Grouse		X	X	X	X	X				X	
Ruffed Grouse							X			X	X
California Quail		X									
Mountain Quail	Cat 2	X									
Virginia Rail							X				

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Sora							X				
American Coot							X				
Semipalmated Plover											
Killdeer							X				
Greater Yellowlegs							X				
Lesser Yellowlegs							X				
Spotted Sandpiper							X				
Western Sandpiper							X				
Least Sandpiper							X				
Dunlin							X				
Short-billed Dowitcher							X				
Long-billed Dowitcher							X				
Common Snipe							X				
Northern Phalarope											
Ring-billed Gull							X				

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
California Gull							X				
Herring Gull							X				
Western Gull								X			
Glaucous-winged Gull								X			
Marbled Murrelet	PT					X					
Rock Dove								X			
Band-tailed Pigeon						X	X				X
Mourning Dove							X				X
Common Barn-owl		X					X		X		
Western Screech-owl							X		X		X
Great Horned Owl		X			X	X	X				X
Northern Pygmy-owl					X	X			X		
Great Gray Owl	A	X			X	X					
Northern Spotted Owl	T					X					
Barred Owl					X	X			X		X

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Snowy Owl		X					X				X
Short-eared Owl							X				
Flammulated Owl	A				X	X			X		
Northern Saw-whet Owl	A	X			X	X			X		X
Common Nighthawk		X					X	X			
Vaux's Swift		X	X			X	X		X		X
Anna's Hummingbird							X				X
Rufous Hummingbird		X	X		X		X				X
Belted Kingfisher							X	X	X		X
Lewis' Woodpecker	A								X		
Acorn Woodpecker									X		
Yellow-bellied Sapsucker							X		X		X
Downy Woodpecker							X		X		X
Hairy Woodpecker					X	X			X		

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Black-backed Woodpecker	A								X		
Three-toed Woodpecker	A				X	X			X		
Northern Flicker		X			X	X			X		X
Pileated Woodpecker	A					X			X		
Olive-sided Flycatcher					X	X					
Western Wood-Pewee			X		X	X					X
Traill's Flycatcher (Willow or Alder)							X				
Hammond's Flycatcher					X	X					
Western Kingbird							X				
Purple Martin	A						X		X		X
Tree Swallow		X				X	X		X		X
Violet-green Swallow							X	X	X		X
Western flycatcher						X	X				
Dusky flycatcher		X	X								

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Ash-throated flycatcher							X				
Northern Rough-winged Swallow							X	X			
Bank Swallow							X	X			
Cliff Swallow							X	X			
Barn Swallow							X				
Gray Jay			X	X	X	X	X				
Steller's Jay			X	X	X	X	X				
Scrub Jay		X	X								
American Crow							X				X
Common Raven		X	X		X	X		X			X
Black-capped Chickadee							X		X		X
Chestnut-backed Chickadee			X	X	X	X	X		X		
Mountain chickadee				X	X			X			
Bushtit		X	X								
Red-breasted Nuthatch					X	X	X		X		
White-breasted Nuthatch							X		X		X

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Brown Creeper					X	X	X		X		
Bewick's Wren							X			X	X
House Wren							X		X	X	X
Winter Wren					X	X				X	X
Long-billed											
Marsh Wren							X				
American Dipper							X				
Golden-crowned Kinglet				X	X	X					X
Ruby-crowned Kinglet		X	X		X	X					X
Western Bluebird	A						X		X		X
Townsend's Solitaire		X	X		X	X		X		X	X
Swainson's Thrush		X	X	X	X	X	X				X
Hermit Thrush		X	X		X	X	X				X
American Robin		X	X	X			X				X
Varied Thrush					X	X					
Wrentit											X

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Water Pipit							X				
Bohemian waxwing							X				X
Cedar Waxwing							X				X
Northern Shrike							X				
European Starling							X		X		X
Solitary Vireo					X	X					
Hutton's Vireo							X				X
Warbling Vireo							X				X
Orange-crowned Warbler		X	X				X				X
Nashville Warbler											X
Yellow Warbler							X				X
Yellow-rumped Warbler		X	X	X	X	X					X
Black-throated Gray Warbler		X	X	X	X	X	X				X
Townsend's Warbler					X	X					

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Hermit Warbler				X	X	X	X				
MacGillivray's Warbler							X				X
Common Yelllowthroat						X					
Yellow-breasted chat							X				
Wilson's Warbler							X				X
House Sparrow		X									
Western Tanager		X			X	X					
Black-headed Grosbeak							X				X
Lazuli Bunting							X				X
Rufous-sided Towhee		X	X				X				X
Chipping Sparrow		X	X				X				X
Vesper Sparrow											X
Savannah Sparrow							X				
Fox Sparrow							X				X

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Song Sparrow							X				X
Lincoln Sparrow							X				
Golden-crowned Sparrow							X				
White-crowned Sparrow		X					X				X
Dark-eyed Junco		X	X		X	X					X
Red-winged Blackbird							X				
Western Meadowlark	A										
Yellow-headed Blackbird							X				
Brewer's Blackbird		X					X				X
Brown-headed Cowbird		X	X				X				X
Northern Oriole							X				X
Purple Finch			X		X	X					X
House Finch											
Red Crossbill					X	X					
Pine Siskin		X	X	X	X	X	X				X

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Lesser Goldfinch							X				X
American Goldfinch							X				X
Evening Grosbeak		X	X	X	X						
MAMMALS											
Virginia Opossum							X		X	X	X
Pacific Water Shrew							X			X	X
Dusky Shrew				X	X	X	X			X	X
Pacific Shrew		X					X			X	
Water Shrew							X			X	X
Trowbridge's Shrew				X	X	X	X			X	X
Vagrant Shrew		X					X				
Shrew-mole				X	X		X			X	X
Coast Mole		X	X								
Townsend's Mole		X									
Pallid Bat	A	X					x				
Big Brown Bat		X				X	X	X	X		X

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Silver-haired Bat			X	X	X	X			X		X
Hoary Bat		X	X		X	X	X				X
California Myotis		X	X	X	X	X	X	X	X		X
Long-eared Myotis					X	X	X		X		X
Little Brown Myotis		X		X	X	X	X	X	X		X
Fringed myotis	BS	X					X	X			
Brazilian free-tailed bat							X				
Long-legged Myotis		X	X		X	X	X		X		X
Yuma Myotis		X			X	X	X	X	X		X
Pacific Big-eared Bat	Cat 2		X				X	X			X
Coyote		X	X				X	X		X	
Gray Fox										X	
Red Fox		X					X			X	
Black Bear		X	X	X	X	X	X			X	
Raccoon		X	X	X	X	X	X		X	X	X
Ring Tail		X	X					X			

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
River Otter							X				X
Marten	A				X	X			X	X	
Fisher	Cat 2				X	X		X	X	X	
Striped Skunk							X				
Ermine		X		X	X	X				X	
Long-tailed Weasel		X	X							X	
Mink							X			X	X
Spotted Skunk		X	X				X	X		X	X
Mountain Lion		X	X		X		X	X			
Bobcat		X	X				X	X		X	X
Roosevelt Elk		X	X	X	X	X	X				X
Black-tailed Deer		X	X	X	X						X
Columbian White-tailed Deer	E						X				
Mountain Beaver		X	X							X	
Northern Flying Squirrel					X	X			X		
Western Gray Squirrel									X		

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
California Ground Squirrel		X									
Townsend's Chipmunk			X	X	X	X			X	X	
Douglas Squirrel			X	X	X	X			X		
Botta's Pocket Gopher		X									
Western Pocket Gopher		X									
Beaver							X				X
Bushy-tailed Woodrat				X	X	X		X		X	
Dusky-footed Woodrat		X	X	X	X	X					X
Deer Mouse		X	X						X		X
White-footed Vole	Cat 2				X	X	X				X
Red Tree Vole				X	X	X					
Western Red-backed Vole				X	X	X					X
California Vole		X									X
Long-tailed Vole		X	X				X				

Appendix 3-8. Wildlife Species and Primary Habitat[1] Affinities in the Roseburg District (cont.)

Species	Species Status[2]	Early Seral	Mid Seral	Late Seral	Mature	Old Growth	Riparian/ Wetland	Cliff/ Talus	Snags	Dead & Downed	Hardwoods
Creeping Vole		X	X				X			X	X
Townsend's Vole		X					X				
Muskrat							X				
House Mouse											
Norway Rat											
Pacific Jumping Mouse		X					X				
Porcupine		X	X	X	X	X		X		X	
Nutria							X				
Pika								X			
Snowshoe Hare		X									
Black-tailed Jackrabbit											
Brush Rabbit		X	X		X						X

[1] Primary habitat is breeding, feeding, or resting habitat within the respective seral stages and unique habitats (after Brown 1985).
[2] Status: Federally Endangered (E); Federally Threatened (T); Federally Proposed (P); Federal Candidate Category 1 (CAT1); Category 2 (CAT2); Bureau Sensitive (BS); Assessment Species (A).

Appendix 3-9
Fish Species in Roseburg Planning Area Streams

Appendix 3-9 Fish Species in Roseburg Planning Area Streams

Nonsalmonid	Salmonid
Western brook lamprey	Chum salmon*
Pacific lamprey	Coho salmon
White sturgeon	Sockeye salmon
American shad	Chinook salmon*
Olympic mudminnow	Cutthroat trout*
Umqua chub	Steelhead (rainbow trout)*
Peamouth	Brown trout
Umpqua Squawfish	
Dace *Rhinichthys spp.*	
Redside Shiners	
Suckers *Catostomus spp.*	
Brown Bullheads	
Channel catfish	
Mosquito fish	
Threespine stickleback	
Striped bass	
Sunfishes *Lepomis spp.*	
Smallmouth bass	
Largemouth bass	
White crappie	
Black crappie	
Yellow perch	
Sculpins *Cottus spp.*	

*Priority species

Source: Brown 1985

Appendix 3-10
Forest Inventory

Before alternative land use plans can be properly developed and considered for forested public lands, information about the land must be available. Some of the most important information is related to the acreage of land suitable for tree growth, the ability of the land to grow trees, the location and condition of the trees and the growth rate and present volume of the trees. The BLM obtains this information primarily through three inventory systems.

Timber Production Capability Classification (TPCC)

The Timber Production Capability Classification (TPCC) is an intensive inventory process initiated in 1972 to categorize all public land administered by BLM in western Oregon based upon the land's physical and biological capacity to produce timber. TPCC was conducted in accordance with Oregon Manual Supplement 5250.

The 1977 TPCC identified commercial forest land which could be managed on a sustained yield basis. This land formed the potential timber production base for computation of the annual allowable harvest. Approximately 390,000 acres were identified in this category. The TPCC also identified about 11,000 acres of commercial forest land that was determined to be incapable of under-going harvest without significant site degradation. This land was left out of the potential timber production base. Sites were placed in this category only when it was judged that economically reasonable technology was not available to mitigate such degradation. The remainder of the district's 424,000 acres was classified as non-forest or non-commercial forest.

In 1977 the TPCC partitioned land within the district into major classes indicating relative suitability to produce timber on a sustained yield basis. The five major classes were high intensity management, limited management, withdrawn, non-forest, and non-commercial forest lands.

High Intensity Management Lands

High intensity managed lands are commercial forest lands that could be managed without undue loss of site productivity and be adequately reforested within specified time limits following regeneration cuts. These lands form the base acreage used to compute the annual sale quantity.

The classification contains two major sub-classes: non-problem sites and restricted sites.

Non-problem sites are commercial forest lands that could be managed by clearcut or partial cut with expectations of adequate regeneration within five years of the regeneration cut using standard reforestation techniques.

Restricted sites are commercial forest lands on which management is limited for timber production. This classification contains three sub-classes: fragile-restricted, both fragile and reforestation-restricted, and reforestation restricted.

Limited Management (Final Harvest Only)

Some regenerated stands in the district are not stocked to the minimum trees per acre specified in reforestation goals. These are identified as limited management only since costs for intensive management practices such as precommercial thinning and fertilization would exceed benefits. Also, growth gains from intensive management practices would not accrue in these understocked stands.

Withdrawn

These are commercial forest lands which, because of their severe physical and biological limitations are not capable of receiving management for wood fiber production without causing site productivity losses and/or result in understocked conditions after five years, and stocked unestablished in 15 years.

These lands are withdrawn from timber production base and are not considered for Allowable Sale Quantity (ASQ) computations. In the case of catastrophe, these sites would be re-analyzed to determine what course of action should be taken to best serve the total resource value.

Also included is an Adverse Location classification which is defined as: sites difficult or impossible to manage because of their physical isolation.

Non-Forest Land

Non-forest lands are areas within the forest zone that are not capable of being at least 10 percent stocked with forest trees, and those lands which were converted to non-forest uses. Examples of non-forest lands are: roads, powerline rights-of-way, rock outcrops, rivers and lakes.

Non-commercial Forest Land

Non-commercial forest lands are lands which are not capable of yielding at least 20 cubic feet of wood per acre per year of commercial species. This classification is divided into two sub-classifications: sites not capable of yielding at least 20 cubic feet per acre per year of a commercial species; or sites on which only non-commercial tree species are capable of growing. Non-commercial species includes all hardwoods, salable or non-salable. If the site contains non-commercial species but is capable of producing more than 20 cubic feet per acre of a commercial coniferous species it is considered to be commercial forest land.

The 1988 TPCC introduced a woodland classification, which is divided into suitable or non-suitable woodlands. Two categories of Commercial Forest Land (CFL) were also established.

CATEGORY I CFL - Sites that can be reforested within five years of harvest using: 1) artificial regeneration and operational reforestation practices; OR 2) natural regeneration in the pine and true fir forest types. A reforested site meets all stocking level standards, seedling criteria, and management goals described in BLM Manual 5705 "Regeneration Stocking Survey". These sites can have a non-problem, fragile, reforestation, or dual (fragile and reforestation) classification.

CATEGORY II CFL - Sites that can be reforested within six to fifteen years of harvest using natural and/or artificial regeneration in all forest types. These sites can have fragile, reforestation, or dual (fragile and reforestation) classifications.

Significant Differences

The 1988 TPCC does not have Limited Management, Adverse Location or Statutory Withdrawal classifications. These lands were reclassified, with the majority being included in the Non-suitable Woodland, Suitable Woodland or Category II CFL classifications.

There are two major differences concerning stocking criteria and silvicultural prescriptions:

Adequately Stocked Criteria

For the 1977 TPCC, all lands classified as CFL would meet the stocking criteria shown below. Stocking is expressed as the minimum number of well-spaced trees per acre (T/A) desired at the time of first intermediate harvest (age 30-50) on an area. The target stocking varies by site productivity class.

Site II	Site III	Site IV	Site V
320 T/A	280 T/A	245 T/A	200 T/A

For the 1988 TPCC, all lands classified as CFL would meet the stocking criteria shown below:

Site II	Site III	Site IV	Site V
150 T/A	150 T/A	150 T/A	100 T/A

As in 1977, stocking is expressed as a minimum number of well spaced trees per acre desired by site class. However, the 1988 standard reflects the desired number of trees per acre at final harvest age (70-80 years).

The change in number of well spaced trees required reflects changes in BLM stocking requirements. The standard used for the 1988 TPCC reflects the fact that biological, environmental, economic, or other factors may preclude achievement of higher stocking on some sites.

The current standard is based on the estimated number of trees per acre needed to fully utilize the sites productivity potential at rotation age. It precludes intermediate harvests but requires sufficient trees per acre for full final harvest volumes.

Standard Silvicultural Operation

Under 1977 guidelines, land was classified Non-problem from a silvicultural standpoint if it could be stocked to the level indicated utilizing "normal silvicultural practices." These practices were defined as those things that would "normally" be done to the land to achieve the desired stocking level. These included planting, prescribed fire, control of competing vegetation, and animal damage control.

Under 1988 guidelines, land was classified Non-problem from a silvicultural standpoint if it could be stocked to the level indicated utilizing "Standard silvicultural practices." These practices were defined as "one planting and one site preparation treatment". Any further action resulted in a restricted classification.

Because of the above differences, a large portion of the CFL was classified as Non-problem in the 1977 TPCC, while the 1988 TPCC has very little land classified as Non-problem.

The TPCC Handbook is available for inspection during normal working hours at the District Office, and provides a complete description of the classifications.

Operations Inventory

For BLM to carry out the timber management program effectively, specific information as to the location and current condition of the various forest types within the land base must be available to the managers. This is accomplished through the Operations Inventory (OI) in accordance with procedures contained in the Operations Inventory Handbook.

The OI is an intensive inventory which divides the forests into survey units sufficiently uniform in composition, condition, operability, productivity, or other characteristics to distinguish them from adjacent units. Information on each unit is maintained in the MICRO*STORMS computer system. Each survey unit has information on location, acreage, stand condition, past management, silvicultural needs and opportunities for application of intensive management practices.

Forest Reinventory Extensive Inventory (5-point)

The purpose of the extensive inventory is to determine the existing volume in the district. A reinventory of commercial forest land was completed in 1988 employing procedures jointly developed by the USFS and BLM. The reinventory used the same basic inventory design used for preparation of the present management plan. The inventory is a stratified random sample of the commercial forest land base. Each plot is a cluster of five sample points. Each point is the center of both a fixed and variable radius plot.

The objective of the inventory is to measure various characteristics, tree growth, tree condition and to estimate the total coniferous volume within plus or minus ten percent (two standard deviations). Statistical analysis indicates that the total conifer volume estimates for merchantable strata on the district is within 8.45 percent for the Douglas Master Unit, based on measurements of 290 plots and 9.59 percent for the South Umpqua Master Unit, based on measurements of an additional 218 plots.

Inventory plots are stratified based on site index, age and major TPCC type (Suitable Commercial Forest Land, Suitable Woodland, Non-Suitable Woodland and Non-forest and Recreation sites).

Table 3-10-1: Stratification of Inventory Plots by SYU

DOUGLAS SUSTAINED YIELD UNIT

STRATA		No. Plots	GIS Acreage	Strata Sampling Error* (90% CL)
10/15	Non-stocked	8	15,130	
11/16	Premerch	119	100,366	19.88
12/17	Young Merch	44	36,115	11.76
13/18	Mature	66	58,586	9.82
14/19	Old-growth	39	72,770	11.33
40/50	Suitable Woodland	2	422	
41/51	Non-suitable Wdld	2	6,153	
60/70	Non-forest/Rec	10	1,900	
	TOTAL	**290**	**291,442**	

Percent Sampling Error* = 8.45 %

SOUTH UMPQUA SUSTAINED YIELD UNIT

STRATA		No. Plots	GIS Acreage	Strata Sampling Error* (90% CL)
10/15	Non-stocked	9	6,486	
11/16	Premerch	69	30,485	26.42
12/17	Young Merch	29	9,741	17.22
13/18	Mature	39	18,405	12.20
14/19	Old-growth	57	34,088	11.19
40/50	Suitable Woodland	1	484	
41/51	Non-suitable Wdld	3	3,627	
60	Non-forest/Rec	11	1,235	
	TOTAL	**218**	**104,551**	

Percent Sampling Error* = 9.59 %

*All sampling errors computed using live and dead cubic volume estimates for both firm and chip material.

Chapter 4
Appendices

Appendix 4-1
Sensitivity Analysis

Sensitivity analysis is a process of identifying specific trade-offs and opportunity costs associated possible changes in single elements of an alternative. Such analyses can help design a preferred alternative that best reconciles potential conflicts and optimizes overall benefits. Because of the number of land-use allocation issues and plan alternatives, BLM found it essential to limit and tightly focus the sensitivity analyses on the most sensitive or controversial issues and primarily on the mid-range alternatives. A number of sensitivity analysis considered early in the formulation of planning criteria were not conducted as the evolution of planning issues and alternatives diminished their relevance.

Some sensitivity analysis conclusions were reached by complex calculations using the detailed analytical tools available for analysis of effects of the full alternatives. Many other conclusions, however, were extrapolated and interpolated from analysis of impacts of the full alternatives. This approach, rather than direct calculation, was always taken where calculation of the impacts of the full alternatives was based on a ten-year timber management scenario developed for each alternative. The effort involved in developing and analyzing such a scenario for each sensitivity analysis was considered unwarranted, due to the time and cost involved.

The following sensitivity analyses were conducted:

- For alternatives B, C, and D, the changes in socioeconomic effects and the effects on anadromous fish populations of differing levels of riparian zone protection, including legally required protection (the alternative A standard). For the preferred alternative, the effects of substituting the alternative A and E levels and the level of protection suggested in October 1991 by the Scientific Panel on Late-Successional Forest Ecosystems, in their watershed/fish emphasis option. The estimated changes in ASQ were based on calculations of changes in riparian acreages excluded from planned timber harvest. Employment effects are linked to ASQ only since no anadromous fish population changes are expected in the short term. For alternative A, the changes in socioeconomic effects and the effects on biological diversity and spotted owl habitat if the timber management areas (old-growth emphasis areas, etc.) and timber management prescriptions of the preferred alternative were incorporated.

- For alternatives B, C, D, and the Preferred, the changes in socioeconomic effects and the effects on biological diversity and spotted owl habitat of differing approaches to old-growth and mature forest protection. These options include:

  Managing the lands allocated for older forest retention in alternative B on a 250- year rotation, with explicit provision for replacement.

  Managing the lands allocated for timber production in alternative B on a 150-year rotation.

  Managing all lands allocated for timber production in alternatives B and C entirely under either of alternatives C's partial retention approaches.

  Managing the lands allocated for timber production entirely for 15 to 20 percent partial retention, but in the first decades not harvesting in the oldest 20 percent of them.

  Substituting the USF&WS proposed spotted owl recovery plan for the older forest or spotted owl protection approach in alternatives B and D.

  Substituting the 50-11-40 rule for provision of connectivity by special management in connectivity areas in the preferred alternative.

  Allocating the restoration and retention blocks of alternative C to 35 + percent partial retention management.

  Accelerating density management in the restoration and retention blocks of alternative C in the first decade to the extent practical.

  A minimum harvest age constraint of 60 years in alternative D (40 years in D in many plans).

  Precluding all timber harvest in old-growth emphasis areas of the preferred alternative.

  No regeneration harvest of stands younger than cumulation of mean annual increment in the preferred alternative.

  No constraint on minimum age of stands subject to regeneration harvest in timber management emphasis areas of the preferred alternative (letting the harvest model select the age that maximizes sustainable ASQ in the decade of the plan).

Foregoing planting genetically selected stock, vegetation management for release and precommercial thinning, fertilization, and stand conversion in the preferred alternative. To be analyzed for each practice individually and for all combined.

In addition , some sensitivity analyses of previously prevalent timber management prescriptions was done for alternative A, as part of the analysis of the management situation. The results of these analyses are displayed in Table 4-1-1.

An analysis was done to test the results of imposing the 50-11-40 rule from alternative D on the GFMA and connectivity areas of the preferred alternative. Additional imformation comparing the quarter townships than meet the 50-11-40 rule under alternatives D and PA can be found in Table 4-16-1 of Appendix 4-16.

Also for the analysis of the management situation, economic efficiency analyses were done for the following intensive management practices: precommercial thinning, commercial thinning, fertilization, and brush and hardwood conversion. These efficiency analyses were based on forestry practices of the 1980s and are less applicable to alternative C and the preferred alternative, particularly since a primary emphasis of many practices in those alternatives is attainment of biological diversity objectives which are not readily valued in economic terms. The measure of economic efficiency is change in net present value (NPV). NPV is the sum of values of revenues less costs during the life of the stand, all values being discounted to the time of harvest of the previous stand. If the change in NPV from adding an intensive management practice is positive, it is considered economically efficient; that is, it adds more value than it costs.

All analysis, including discount rates, was based on values net of inflation. This is called using real prices instead of nominal prices. The basis of expected timber stumpage prices is the average BLM timber sale price for the 1984-1988 period. For the primary analyses, future real wood price increases were estimated at 1.2 percent annually, based on the U.S. Forest Service's 1989 Resources Planning Act assessment. A discount rate of four percent was used because it was considered to best represent the long-term outlook. Analyses of precommercial thinning, commercial thinning and fertilization for each site index were made of both understocked and well-stocked stands, assuming final harvest ages of 50, 60, 70, and 80 years. In general, fertilization or a combination of fertilization and commercial thinning results in a positive NPV for stands harvested at age 60.

For comparison and sensitivity testing, identical analyses were made using the following alternative assumptions: (1) zero real wood price increase and four percent discount rate, (2) 1.2 percent real wood price increase and seven percent discount rate, and (3) zero real wood price increase and seven percent discount rate. Under the first assumption , commercial thinning results in a positive NPV in all tests and fertilization results in a positive NPV in about one-half of the analyses. Precommercial thinning analyses indicates a negative NPV in most analyses. Under the second assumption, commercial thinning again results in a positive NPV for all analysis and fertilization and precommercial thinning indicate a negative NPV for all analyses. Under the third assumption, the results were similar to those for the second assumption.

Analysis of hardwood, brush or grass site conversion to conifers focused on estimating the maximum amount which could be spent on the practice while achieving a positive NPV. Generalized conclusions about economic efficiency of this practice were not reached , as the cost of conversion varies widely from site to site. Among the relevant factors in site-specific analysis would be the stumpage value of any trees on a site. At 1.2 percent real wood price increase, with a four percent discount rate, up to $1,406 per acre could be spent if harvest at age 60 was expected. The maximum amount economically feasible for any site declines as harvest age lengthens. Under other economic assumptions tested, it is also lower.

Complete documentation of the Economic Efficiency Analysis is available in the District Analysis of the Management Situation.

Table 4-1-1 Sensitivity Analysis of Land Use Allocations

Allocation Element	Base Alt.	Allocation	Annual ASQ Change (MMCF)	Annual ASQ Estimate (MMCF)	Annual ASQ Change (MMBF)	Annual ASQ Estimate (MMBF)	Local Employment (Direct Jobs) (@ 10 Years)	Biological Diversity Local Employment (Total Jobs) (@10 Years)	County Revenue ($1000) (@100 Years)	Spotted Owl Habitat (@100 Years)	Structural Diversity (@100 Years)	Old Growth (Acres) (@100 Years)
Riparian Zone Protection	B	Alt. A	0.36	44.38	2.39	293.33	119	228	$2,266			
	B	Alt. C	-0.95	43.07	-6.26	284.68	-312	-596	($5,927)			
	C	Alt. A	0.40	11.62	2.64	76.61	132	256	$2,867			
	C	Alt B	0.29	11.51	1.91	75.88	95	185	$2,074			
	C	Alt. D	-1.03	10.19	-6.80	67.17	-341	-660	($7,400)			
	D	Alt. A	2.03	16.36	12.99	104.69	670	1299	$14,461			
	D	Alt. C	1.36	15.69	8.73	100.43	450	873	$9,719			
	D	Alt. E	-0.35	13.98	-2.27	89.43	-117	-227	($2,523)			
	PA	Alt. A	0.69	16.99	4.42	109.02	227	441	$4,826			
	PA	Alt. E	-1.00	15.30	-6.42	98.18	-330	-640	($7,011)			
Old Growth and Owl Recovery Plan	B	No Protection	3.36	47.38	22.233	313.17	1110	2119	$21,055	—	—	—
	B	150-yr Rotation on Managed Lands	-28.86	15.16	-190.41	100.53	-9524	-18182	($180,702)	+	–	+
	B	BD-2(Low) Retention	-27.37	16.65	-182.46	108.48	-9032	-17243	($171,372)	+	–	+
	B	BD-1 (High)	-32.52	11.50	-215.00	75.94	-10733	-20490	($203,646)	+	+	+
		Rentention on Managed Lands										
	B	Proposed Spotted Owl Recovery Plan	-17.86	26.16	-118.01	172.93	-5892	-11249	($111,802)	+	+	+
	C	All 15-20% Partial Retention	2.67	13.89	16.53	90.50	881	1709	$19,147	—	o	—
	C	All 35% + Partial Retention	-1.63	9.59	-10.62	63.35	-538	-1043	($11,689)	o	+	+
	C	All 15-20% Partial Retention but No Harvest of Oldest 20%	1.57	12.79	9.36	83.33	518	1005	$11,259	—	+	—
	C	35% + Partial Retention in R&R Blocks	2.39	13.61	15.81	89.78	790	1532	$17,162	o	—	o

Table 4-1-1 Sensitivity Analysis of Land Use Allocations (cont.)

Allocation Element	Base Alt.	Allocation	Annual ASQ Change (MMCF)	Annual ASQ Estimate (MMCF)	Annual ASQ Change (MMBF)	Annual ASQ Estimate (MMBF)	Local Employment (Direct Jobs) (@ 10 Years)	Biological Diversity Local Employment (Total Jobs) (@10 Years)	County Revenue ($1000) (@100 Years)	Spotted Owl Habitat (@100 Years)	Structural Diversity (@100 Years)	Old Growth (Acres) (@100 Years)
	C	Accelerated Density Mgmt. in R&R Blocks	0.24	11.64	2.22	76.19	139	269	3,012	o	+	o
	D	Proposed Spotted Owl Recovery Plan	-2.03	12.30	-12.97	78.73	-669	-1298	($14,446)	+	+	+
	D	60-Year Minimum Harvest Age	-0.50	13.83	-3.20	88.50	-165	-320	($3,562)	o	o	o
	PA	50-11-40 Rule for GFMA and Connectivity Areas	-1.73	14.57	-11.34	93.26	-570	-1105	($12,101)	o	+	o
	PA	No Harvest in OGEAs	0.00	16.30	0.00	104.60	0	0	$0	o	+	o
	PA	No Harvest Below CMAI	-2.04	14.26	-12.36	92.25	-673	-1306	($14,298)	o	+	o
	PA	Max. Legal Timber Prod. w/Alt A Other Allocations	2.31	18.61	14.85	119.45	764	1481	$16,221	o	—	o
	PA	Scientific Panel	-1.40	14.90	-9.00	95.60	-463	-897	($9,825)	o	o	o
		Watershed										
	PA	Unconst Harvest Age in GFMA	4.50	20.80	26.49	131.09	1485	2880	$31,539	—	—	o
	PA	No Genetic Stock	-0.06	16.24	-4.82	99.78	-20	-38	($421)			
	PA	No Release and PCT	0.00	16.30	-4.40	100.20	0	0	$0			
	PA	No Fertilization	0.00	16.30	-3.63	100.97	0	0	$0			
	PA	No Stand Conversion	0.00	16.30	-3.63	100.97	0	0	$0			
	PA	No Intensive Mgmt Practices	-0.34	15.96	-6.63	97.97	-112	-218	($2,383)			

Appendix 4-2
Analytical Assumptions About Global Climate Change

Many scientists have predicted significant global warming within the next sixty years, due to increasing levels of carbon dioxide and other gases in the atmosphere. Others have further hypothesized a climate change in western Oregon that would make it difficult or impossible to maintain, without change, the current ecosystems, including the major forest tree species. Among the relevant uncertainties, it is expected that warmer, drier weather would increase the incidence of wildfire, but warmer, wetter weather might reduce it. Rapid change may make the forest more susceptible to insect and disease attack because generational succession occurs much more quickly among pests than among trees. Other possible effects include raising soil temperatures and lengthening summer droughts. This could shift the range of Douglas-fir forest toward higher elevations, reduce the range for current high-elevation species, and increase the range for dryland species such as lodgepole and ponderosa pine. Thus, management practices, particularly stand establishment and manipulation, could be affected. Assuring adequate tree regeneration would probably be the most serious management problem in areas that become marginal. (Greenhouse Gases, Climate Change and U.S. Forest Markets - James L. Regens, Frederick W. Cubbage and Donald G. Hodges - Environment, May 1989, 31:4).

There is, however, no scientific consensus about the expected extent or rate of global warming or the probable effect on forest ecosystems in western Oregon. Neither the environmental record nor the limited capabilities of the climate models permit a reliable forecast of climate changes. (Policy Implications of Greenhouse Warming - National Academy of Sciences, 1991). Furthermore, available models show marked differences in their predictions of change in western Oregon. (Climate Change and America's Forests - Linda A. Joyce, Michael A. Fosberg, and Joan M. Comanor - USDA Forest Service, General Technical Report RM-187, 1990). In addition, the most commonly predicted temperature changes are not expected to affect woody biomass production or the dominance of Douglas-fir in the region, although they could alter codominant species composition in older forests. (Potential Effects of Climate Change on Stand Development in the Pacific Northwest - V.H. Dale and J.F. Franklin - Canadian Journal of Forest Research, 19(12), 1989). At the high end of the range of predicted changes, however, are temperature increases that could be great enough, by around the middle of the 21st century, to inadequately meet the winter "chilling requirement" for Douglas-fir to start growth again in the spring. (Predicted Global Climate Change and the Chilling Requirement of Conifers - D.P. Lavender. Paper presented at Western Forestry Conference, Sacramento, California, 1989).

The increasing carbon dioxide levels are generally thought to be beneficial to plant growth, but available information does not suggest which forest tree species may be most responsive to that increase or how their responsiveness may also be affected by any changes in climate or by fertilization in managed forests.

Although climate change may occur and may, in a number of decades, affect the species composition of the forest, it is not considered likely to affect forestry practices during the ten-year life of the plan. Nonetheless, the draft plan incorporates a process of adaptive management (see Chapter 2, Management Direction Common to All Alternatives, Use of the Plan) permitting effective response to changing knowledge. Thus, should a scientific consensus emerge during the life of the plan, indicating that forestry practices should be modified promptly in anticipation of the effects of global warming, BLM will be able to adjust.

Appendix 4-3
Ten Year Mineral Development Scenarios

Introduction

This appendix describes the Reasonably Foreseeable Development (RFD) scenarios for development of leasable, locatable and salable mineral commodities. The purpose of the RFDs is to provide models that anticipate the level and type of future mineral activity in the planning area. These scenarios and known impacts from past activity will serve as a basis for cumulative impacts analysis. The RFD first describes the steps involved in developing a mineral deposit, with presentation of hypothetical exploration and mining operations. The current activity levels are discussed in Chapter 3 of this document. Future trends and assumptions affecting mineral activity are discussed here, followed by the prediction of the surface impacts of the anticipated mineral exploration and development.

Scope

The development scenario is limited in scope to BLM-administered lands in the planning area. The RFD is based on the known or inferred mineral resource capabilities of the lands involved, and applies the conditions and assumptions discussed under Future Trends and Assumptions. Changes in available geologic data and/or economic conditions would alter the RFD, and some deviation is to be expected over time.

Leasable Minerals

Reasonably Foreseeable Development of Oil and Gas Resources (Common to All Alternatives)

Future Trends and Assumptions

Based on the history of past drilling and foreseeable development potential in the operating area, activity over the next decade will continue to be sporadic. It is not anticipated that there will be a discovery of producible oil or gas fields in the Roseburg District during the plan period. However, to comply with the Supplemental Program Guidance for Fluid Minerals (Manual Section 1624.2), the potential surface impacts associated with the discovery and development of a small gas field are outlined below. It is anticipated that oil and gas activity will consist of the issuance of some competitive and over the counter leases, a few geophysical surveys, and perhaps the drilling of three exploratory wells.

The supply of natural gas in the region has been plentiful and is forecasted to remain that way in the future. The price of natural gas has gone down recently and it is predicted that future prices may stay at or close to the current price. Recent economic conditions within the oil industry resulted in a decline in the number of active exploratory wells being drilled in other parts of the nation. Continued low prices and depressed economic conditions would result in a nationwide decrease in domestic exploration and development. A turnaround in the oil industry or, an increase in the price of oil and gas purchased from other countries, would spur an increase in demand for domestic production, increasing the number of wells drilled.

Development of Oil and Gas Resources

Geophysical Explorations

Geophysical exploration is conducted to try to determine the subsurface structure of an area. Three geophysical survey techniques are generally used to define subsurface characteristics through measurements of the gravitational field, magnetic field, and seismic reflections.

Gravity and magnetic field surveys involve small portable measuring units which are easily transported via light off-road vehicles, such as four-wheel drive vehicles, or aircraft. Both off-road and on-road travel may be necessary in these two types of surveys. Usually a three-man crew transported by one or two vehicles is required. Sometimes small holes (approximately one inch by two inches by two inches) are hand dug for instrument placement at the survey measurement points. These two survey methods can make measurements along defined lines, but it is more common to have a grid of discrete measurement stations.

Seismic reflection surveys are the most common of the geophysical methods, and they produce the most detailed subsurface information. Seismic surveys are conducted by sending shock waves, generated by a small explosion or through mechanically beating the ground surface with a thumping or vibrating platform, through the earth's surface. The thumper and vibrator methods pound or vibrate the ground surface to create a shock wave. Usually four large trucks are used, each equipped with pads about four foot square. The pads are lowered to the ground, and the vibrators are electronically triggered from the recording truck. Once information is recorded, the trucks move forward a short distance and the process is repeated. Less than 50 square feet of surface area is required to operate the equipment at each recording site.

The small explosive method requires that charges be detonated on the surface or in a drill hole. Holes for the charges are drilled utilizing truck-mounted or air portable drills to drill small-diameter (two to six inches) holes to depths of 100-200 feet. Generally four to 12 holes are drilled per mile of line and a five to 50-pound charge of explosives is placed in the hole, covered, and detonated. The created shock wave is recorded by geophones placed in a linear fashion on the surface. In rugged terrain, a portable drill carried by helicopter can sometimes be used. A typical drilling seismic operation may utilize 10-15 men operating five to seven trucks. Under normal conditions, three to five miles of line can be surveyed daily using this method. The vehicles used for a drilling program may include heavy truck-mounted drill rigs, track-mounted air rigs, water trucks, a computer recording truck, and several light pickups for the surveyors, shot hole crew, geophone crew, permit expert, and party chief.

Public and private roads and trails are used where possible. However, off-road cross-country travel is also necessary in some cases. Graders and dozers may be required to provide access to remote areas. Several trips a day are made along a seismograph line, usually resulting in a well defined two track trail. Drilling water, when needed, is usually obtained from private land-owners.

A Notice of Intent authorizes geophysical exploration when there is no mineral lease on the tract. It is anticipated that one Notice of Intent, involving seismic reflection surveys will be filed during the life of this plan.

The surface charge method utilizes one to five pound charges attached to wooden laths three to eight feet above the ground. Placing the charges lower than six feet usually results in the destruction of vegetation, while placing the charges higher, or on the surface of deep snow, results in little visible surface disturbance.

Surface Impacts of Geophysical Explorations

It is anticipated that the foreseeable geophysical explorations for oil and gas on the Roseburg District will consist of seismic reflection surveys, utilizing approximately ten miles of existing roads. Surface impacts will involve temporary blockage of the roads by the four large trucks used to gather the data with a vibrating platform, but no damage to the roads is expected using this type of equipment.

The small explosive method is also anticipated to be used on an additional ten miles of line. Surface disturbance for this type of geophysical exploration is expected to consist of drilling four holes per mile of line, totalling 40 drill holes. Each drill hole will impact about 200 square feet, but 36 of these holes will be drilled on existing landings, spur roads, or timber haul roads. Therefore, 7,200 square feet (approx. 0.2 acre) of existing road surface will temporarily be impacted by drilling activities and low power blasting. Blasting will not be powerful enough to impact any surface resources or improvements. It is anticipated that four drill holes will be made on areas currently undeveloped. The drill pads will impact approximately 200 square feet each with short spur roads (100 feet long and 25 feet wide) constructed to each drill hole location. Surface disturbance of these four drill holes would affect approximately 0.25 acres. The total surface disturbance using the drilling, blasting method is expected to impact 0.5 acre.

Drilling Phase

One Notice of Staking is anticipated during the plan period. It is anticipated that the company would then also submit an Application to Drill (APD) after the Notice of Staking is accepted. Private surface owner input will be actively solicited during this stage. Once the APD is approved, the operator may begin construction activities in accordance with stipulations and conditions. When a site is chosen that necessitates the construction of an access road, the length of road may vary, but usually the shortest feasible route is selected to reduce the haul distance and construction costs. Environmental factors or a landowner's wishes may dictate a longer route in some cases. Drilling activity in the planning area is predicted to be done using existing roads and constructing short (approximately one-quarter mile) roads to access each drill site location.

Based on past oil and gas drilling in Oregon and for analysis purposes, it is projected that three exploratory "wildcat" wells will be drilled on BLM-administered land in the planning area. The estimated success rate of

finding hydrocarbons is predicted to be no greater than ten percent, based on the average U.S. wildcat well success rate. Drilling is expected to be in an area of "high" oil and gas potential which is the highest level of potential for oil and gas on this District. There is approximately a one in 50 chance of new field discovery during the life of the plan, with a strong likelihood that any such discovery would be natural gas, since current western Oregon production to date has been natural gas.

Surface Impacts of Drilling

During the first phase of drilling, the operator will move construction equipment over existing maintained roads to the point where the new access road begins. No more than a quarter of a mile of moderate duty access road per well site is anticipated to be constructed. The surface disturbance for new road building will average 40 feet wide with ditches, cuts and fills for a quarter of a mile in length, therefore the acreage impacted by road building will approximately 1.25 acres for each well. For the three anticipated wells, a total of 3.75 acres would be needed for new road construction.

The second part of the drilling phase is the construction of the drilling pad or platform, anticipated to involve approximately two acres per well site. Support facilities are anticipated to disturb about two acres per well site. The likely duration of well development, testing, and abandonment is predicted to be approximately six months for each drill site. Therefore, the total disturbance for the three exploratory wells, support services, and new road construction is expected to be no more than a total of approximately 12 acres.

Producing Phase

One gas field of 50 - 60 Bcf could be discovered on BLM-administered lands at a depth of 2,000 to 3,000 feet during the plan period. It is estimated that the productive life span of this field would be about ten years. The size of the field would be approximately 200 acres and the well spacing would be about 160 acres (one well per quarter section). It is anticipated that the field would require four development wells in addition to the discovery well. All gas production would be carried by pipelines for a distance of approximately 40 miles. All well service requirements would be provided by established service companies.

Surface Impacts of Field Development and Production

Each development well pad would be approximately two acres in size and, as a result, a total of eight acres would be involved in drill pad construction. New roads leading to each of these drill pads would have to be constructed and it is estimated that each of the new roads would be about 1/4 mile in length with a right-of-way width of 40 feet. Therefore, approximately 1.25 acres would be involved for each newly constructed road, and the total surface disturbance attributed to new road construction would be five acres. A pipeline 40 miles long with a right-of-way of 30 feet would disturb about 145 acres. Due to the checkerboard public land ownership in this area, it is estimated that only about one-half of that acreage would be on public lands administered by the BLM. Therefore, it is estimated that about 73 acres would be impacted from pipeline construction.

The total surface disturbance of field development and production would be approximately 86 acres.

Plugging and Abandonment

Wells that are completed as dry holes are plugged according to a plan designed specifically for the down hole conditions of each well. Plugging is accomplished by the placing of cement plugs at strategic locations downhole and up to the surface. Drilling mud is used as a spacer between plugs to prevent communication between fluid bearing zones. The casing is cut off at least three feet below ground level and capped by welding a steel plate on the casing stub. It is predicted that the one exploratory well drilled, will be plugged and abandoned.

Surface Impacts of Plugging and Abandonment

After plugging, all equipment and debris would be removed and the drill site would be restored as near as reasonably possible to its original condition. If the new roads constructed for drilling are not needed for future access to the area, the roads would be reclaimed as required by the Authorized Officer.

Reasonably Foreseeable Development of Geothermal Resources (Common to All Alternatives)

Future Trends and Assumptions

With environmental protection and enhancement being a major consideration in the Pacific Northwest, clean, low-impacting energy sources are becoming more important. The energy surplus in the region is expected to be gone near the end of the decade. The abundant geothermal resources thought to be present in the Northwest are essentially undeveloped. To encourage resource development, the Bonneville Power Administration is offering to participate in three geothermal pilot projects. One of the projects selected is in the Medicine Lake Highlands area in northern California, just south of the planning area. With this renewed interest in geothermal energy it is anticipated that areas exhibiting geothermal potential, such as Klamath Falls, will experience an increase in geothermal exploration and possibly development.

Development of Geothermal Resources

Geophysical/Geochemical Exploration

As with oil and gas, geothermal geophysical operations can take place on leased or unleased public land. Depending upon the status of the land (leased/unleased), the status of the applicant (lessee/nonlessee), and the type of geophysical operation proposed, (drilling/non-drilling), several types of authorizations can be used if the proposed exploration exceeds "casual use", as defined in 43 CFR 3209.0-5(c). In all cases, the authorizations require compliance with the National Environmental Policy Act and approval by the Authorized Officer. As with oil and gas, the operator is required to comply with all terms and conditions of the permits, regulations, and other requirements, including reclamation, prescribed by the Authorized Officer. Monitoring for compliance with these requirements will be done during the execution of the operations and upon completion.

In addition to the geophysical methods discussed in the Oil and Gas section, the following exploration techniques are often employed in geothermal prospecting:

Microseismic: Small seismometers are buried at a shallow depth (hand-dug holes) and transmit signals from naturally-occurring, extremely minor seismic activity (micro-earthquakes) to an amplifier on the surface. Stations are located away from roads to avoid traffic "noise". These units are often backpacked into areas inaccessible to vehicles.

Resistivity: Induced polarization (IP) techniques are used to measure the resistance of subsurface rocks to the passage of an electric current. A vehicle-mounted transmitter sends pulses of electrical current into the ground through two widely spaced electrodes (usually about two miles apart). The behavior of these electrical pulses as they travel through underlying rocks is recorded by "pots" (potential electrodes), small ceramic devices that receive the current at different locations. The electrodes are either short (two to three feet) rods driven into the ground, or aluminum foil shallowly buried over an area of several square feet. Two or three small trucks transport the crew of three to five people to transmitting and receiving sites.

Telluric: A string of "pots" record the variations in the natural electrical currents in the earth. No transmitter is required. Small trucks are used to transport the crew and equipment.

Radiometric: Radioactive emissions (generally radon gas) associated with geothermal resources are usually measured using a hand-held scintillometer, often at hot spring locations. Another method used involves placing plastic cups containing small detector strips sensitive to alpha radiation either on the surface or in shallow hand-dug holes. If holes are dug, they are covered, and the cups left in place for three to four weeks. At the end of the sampling period, the cups are retrieved and all holes are backfilled. These surveys can be conducted on foot or with the aid of light vehicles.

Geochemical Surveys: Geochemical surveys are usually conducted at hot springs by taking water samples directly from the spring. Sampling for mercury associated with geothermal resources is often done by taking soil samples using hand tools. These surveys can be conducted on foot or with the aid of light vehicles.

Temperature Gradient Drill Hole Surveys: Temperature gradient holes are used to determine the rate of change of temperature with respect to depth. Temperature gradient holes usually vary in diameter from about 3i - 4i inches, and from a few hundred feet to about 5000 feet in depth. They are drilled using rotary or coring methods. Drilling mud and fluids would be contained in earthen pits or steel tanks. Water for drilling would be hauled in water trucks, or if suitable water sources are close, could be piped directly to the

site. Water consumption could range from about 2,000-6,000 gallons per day, with as much as 20,000 gallons per day under extreme lost circulation conditions.

Depending upon the location and proposed depth of the drill hole, detailed plans of operation that cover drilling methods, casing and cementing programs, well control, and plugging and abandonment may be required.

Based upon past geothermal exploration in Oregon, the area's potential, and recognizing a projected increase in power demand in the northwest by the end of the decade, it is anticipated that during the 10 year life of this plan, no Notices of Intent for surface geophysical surveys, and no Notice of Intent to drill temperature gradient holes will be filed. For analysis purposes, two notices of intent for geophysical work and one notice of intent for drilling for two holes will be analyzed.

Surface Impacts of Geothermal Exploration

The surface impacts of geophysical surveys (micro-seismic, resistivity, telluric, radiometric and geochemical) are anticipated to be negligible, utilizing existing roads for vehicle access to or near the exploration area. Exploration areas for the small seismometers, electrodes, and geochemical sampling areas are not anticipated to exceed 0.1 acre (total).

The surface disturbance anticipated from two temperature gradient holes is anticipated to involve 0.1 acre per drill site, involving 0.2 acre total. Each drill site could contain the drill rig, most likely truck mounted, water truck(s), fuel tank, supply trailer, and a small trailer for the workers. Drilling mud and fluids would be contained in earthen pits or steel tanks. Water for drilling would be hauled in water trucks, or if suitable water sources are nearby, could be piped directly to the site. Water consumption could range from about 2,000-6,000 gallons per day, with as much as 20,000 gallons per day under extreme lost circulation conditions. Existing roads would be used, but short spur trails (probably less than 500 feet long and 20 feet wide) would be constructed for both of these holes, affecting approximately 0.5 acre. Both holes would be plugged and abandoned to protect both surface and subsurface resources, including aquifers. Reclamation of disturbed areas would be required, unless some benefit to the public could be gained, such as a water well or camping area.

Drilling and Testing

Drilling to determine the presence of geothermal resources or to test, develop, produce, or inject these resources can be done only on land covered by a geothermal resources lease. Close coordination with the State would take place. It is anticipated that the duration of well development, testing, and if dry, abandonment, would be four months.

Prior to abandonment, the operator would be required to plug the hole to prevent contamination of aquifers and any impacts to subsurface and surface resources. Plugging is accomplished by the placing of cement plugs at strategic locations downhole and up to the surface. Depending upon the formations encountered, drilling mud could be used as a spacer between plugs to prevent communication between fluid bearing zones. The casing is cut off at least six feet below ground level and capped by welding a steel plate on the casing stub.

It is estimated that one exploratory well would be drilled during the 10 year life of this plan.

Surface Impacts of Drilling

The geothermal well drilling operation would require approximately one acre for a well pad, including reserve pit. It is expected that existing roads would be used to access the drill site but about a half mile of moderate duty access road up to 40 feet wide with ditches, cuts, and fills, would also be necessary. Approximately 2.5 acres would be disturbed by this new road construction. Total surface disturbance for the well and new road construction is expected to be about 3.5 acres.

After plugging, all equipment and debris would be removed, and the site would be restored as near as reasonably possible to its original condition. A dry hole marker would be placed at the surface or buried to identify the well location. If the new road is not needed for other purposes, it would be reclaimed as directed by the Authorized Officer.

Geothermal Power Plant Development

It is projected that no power plants will be constructed on BLM lands in the operating area during the life of this plan.

Direct Use of Geothermal Energy

It is projected that no direct use of geothermal energy will be utilized on BLM lands in the operating area during the life of this plan.

Locatable Minerals

Reasonably Foreseeable Development of Locatable Mineral Resources (Common to All Alternatives)

Future Trends and Assumptions

The major commodities of interest will continue to be the precious metals, gold and silver. This is based on a combination of price (especially gold) and the favorable geology for mineral occurrences. Reclamation science will continue to advance due to experience and research. A more detailed design effort will be placed on the reclamation of mined lands in the future. This will result in an overall increase in reclamation costs but those costs should pay dividends in the long-term with increased reclamation success.

The economics of mining in the planning area will be driven by the relationship between production costs and the market price of the commodity. While production costs can be controlled, or anticipated through management and technology, the big unknown will be in the price of the mineral commodities, especially gold. The overall profitability of an operation, and hence the level of activity at the prospecting, exploration, and mining phases, for development of ore bodies will be closely related to the price of the mineral commodity.

No chemical heap leaching operations are forecasted during the plan period. If such an operation is proposed during the life of the plan, it will be subjected to environmental review under a Plan of Operations pursuant to regulations found in 43 CFR 3809. All locatable mineral operations will be monitored pursuant to these regulations and the policies shown below.

Development of Locatable Mineral Resources

Exploration Phase

Reconnaissance

Reconnaissance level activity is the first stage in exploring for a mineral deposit. This involves the initial literature search of an area of interest, using available references such as publications, reports, maps, aerial photos, etc. The area of study can vary from hundreds to thousands of square miles. Activity that will normally take place includes large scale mapping, regional geochemical and geophysical studies, and remote sensing with aerial photography or satellite imagery. The type of surface disturbing activity associated with reconnaissance level mineral inventory is usually no more than occasional stream sediment, soil or rock sampling. Minor off-road vehicle use may be required.

Prospecting

As the result of anomalous geochemical or geophysical readings, an unique geologic structure or feature, an occurrence of typical mineral bearing formations, or a historical reference to past mineral occurrence, the prospecting area of interest is identified through reconnaissance. This area may range from a single square mile to an entire mountain range of several hundred square miles.

Activity that will take place in an effort to locate a mineral prospect includes more detailed mapping, sampling, geochemical and geophysical study programs. This is the time when property acquisition efforts usually begin and most mining claims are located in order to secure ground while trying to make a mineral discovery.

Surface Impacts of Reconnaissance and Prospecting

Types of surface disturbing activity associated with prospecting generally involve soil and rock chip sampling using mostly hand tools, possibly off-road vehicle use, and placement and maintenance of mining claim monuments. This activity is normally considered "casual use" (43 CFR 3809.1-2) and does not require BLM notification or approval. Surface disturbances by these activities are anticipated to be less than 0.01 acre for each prospecting venture.

Exploration

Upon location of a sufficiently anomalous mineral occurrence, or favorable occurrence indicator, a mineral prospect is established and is subjected to more intense evaluation through exploration techniques. Activities that take place during exploration include those utilized during prospecting but at a more intense level in a smaller area. In addition, activities such as road building, trenching, and drilling are conducted. In later stages of exploration, an exploratory adit or shaft may be driven. If the prospect already has underground workings these may be sampled, drilled, or extended. Exploration activities utilize mechanized earth moving equipment and drill rigs, and may involve the use of explosives.

Surface Impacts of Placer Exploration

Placer exploration consists of test pit digging either by hand or with a backhoe or hydraulic excavator. It is predicted that ten Notices will be filed pertaining to placer deposit exploration. A typical Notice will describe minor road construction necessary for accessing three test pit locations. The size of each test pit is predicted to be about five feet x five feet and ten to 15 feet deep. It is anticipated that three temporary access roads approximately 200 feet long and 25 feet wide will be necessary to reach the test pit locations with the equipment, affecting roughly a total of 0.3 acre for new roads. Support facilities would utilize approximately one acre. Therefore, each Notice-level operation would utilize approximately 1.3 acres of land, and during the plan period the expected ten operations would disturb about a total of 13 acres of land.

If low mineral values are discovered, then the pits will be backfilled and the area seeded and fertilized. It is anticipated that one notice-level operation will find mineral values significant enough to develop into a plan-level of operation which is described as a bench placer mine development later in this appendix.

Surface Impacts of Lode Exploration

It is anticipated that 20 Notices will be filed, pertaining to vein lode exploration. Exploratory work including drilling, blasting, and bulk sampling will be the emphasis of these projected notice-level operations. Some road and trail construction is anticipated for the operator to access the exploration sites for sample collection.

For each Notice, it is anticipated that three temporary access roads, 200 feet long by 40 feet wide (including cuts, fills, and ditches), would be necessary for equipment to reach the exploration sites. Surface disturbance for roads therefore, would be approximately 0.5 acre per notice. Support facilities would most likely be needed and would involve the use of about one acre per notice. The mineral sample sites (including three drill sites and two bulk sample sites) would probably disturb about 0.5 acre. Therefore, for each notice, approximately two acres would be affected by exploration of lode mineral deposits, and for the 20 Notices, a total of approximately 40 acres would be affected.

It is anticipated that one Plan of Operation would be filed during the plan period pursuant to 43 CFR 3809.1-4. It is predicted to be a disseminated gold exploration project, and approximately ten holes would be drilled utilizing truck mounted drill rigs. Each drill site would disturb less than a tenth of an acre. Temporary access roads, would be constructed for about three of the drill holes, but in most cases the existing roads would be utilized. Each of these temporary access roads would be approximately 300 feet long and 40 feet wide, including roadcuts, ditches, and fill slopes involving approximately 0.25 acre for each road (0.75 acre total). Support facilities might be necessary, affecting approximately one acre. Therefore, during the first phase of exploration, it is anticipated that 2.75 acres would be disturbed.

In the second phase of exploration, it is predicted that the operator will conduct drilling and sampling on a defined grid in order to better evaluate the amount of ore reserves within the project area. Additional equipment access roads will be necessary to complete this exploratory drilling and it is estimated that ten temporary access roads (of the length and width mentioned above) would be necessary in order to conduct this drilling, affecting about 2.5 acres. The ten new drill holes would disturb about a total of one acre. Therefore, the second phase of exploration would disturb an additional 3.5 acres. The total anticipated acreage involved in the plan-level lode exploration project would be approximately 6.25 acres.

Mining Phase

Mine Development

If exploration results show that an economically viable mineral deposit is present, activity intensifies to obtain detailed knowledge regarding reserves, possible mining methods, and mineral processing requirements. This involves applying all the previously utilized exploration tools in a more intense effort. Once enough information is acquired, a feasibility study is made to decide whether to proceed with mine development and which mining and ore processing methods will be utilized. It is anticipated that one bench placer and one

lode deposit will be developed during the duration of this resource management plan. Both operations would be monitored under approved plans of operation.

Once the decision to develop the property is made, the mine permitting process begins. Upon approval, work begins on development of the mine infrastructure. This includes construction of the mill, offices and laboratory; prestripping in preparation for open pit mining; building of access roads or haulage routes, and placement of utility services. During this time, additional refinement of ore reserves is made.

Once enough facilities are in place, actual mine production begins. Concurrent with production there often are "satellite" exploration efforts to expand the mine's reserve base and extend the project life. Reclamation of the property is conducted concurrently with, or upon completion of, the mining operation. Often subeconomic resources remain unmined and the property is dormant, waiting for changes in commodity price or production technology that would make these resources economic.

Activities that could occur on these lands include: actual mining, ore processing, tailings disposal, waste rock placement, solution processing, metal refining, and placement of support facilities such as repair shops, labs, and offices. Such activities involve the use of heavy earthmoving equipment and explosives for mining and materials handling, exploration equipment for refinement of the ore reserve base, hazardous or dangerous reagents for processing requirements, and general construction activities.

The size of mines varies greatly and not all mines would require all the previously mentioned facilities and equipment. Acreage involved can range from several acres to several hundred, with most projects disturbing ten acres or less and requiring either a Notice or a Plan of Operations.

Bench Placer Mine

Bench placer operations can vary in size from one person to six persons operating excavators, backhoes, loaders, larger dozers, trommels, vibratory wash plants, draglines, and sluice boxes. Other associated equipment includes water pumps, generators, and conveyors. These operations vary in scope, processing between 10 to 500 loose cubic yards of gravel per day. The average operation of this type processes 50 cubic yards per day, operating 90 days per year.

The mining process could be generalized as follows: vegetation and overburden clearing, excavation of bench gravels, haul mineral bearing gravels to processing plant, washing gravel in plant with water, concentration of heavy metal in sluice box, and placement of tailings back into the excavated area as part of the reclamation plan.

Surface Impacts of Bench Placer Development

It is anticipated that the excavation area for mineral extraction would disturb approximately five acres. The finer material that washes over the sluice box is allowed to settle out in settling ponds to prevent siltation of adjacent streams. The water in the pond can be recycled through the wash plant to conserve water, and after the tailings are contoured for reclamation, the soil can be spread over the gravels and reseeded. Other associated activities include the need for support facilities (0.75 acre), road construction for access and ore haul routes (approximately 0.75 acre), construction of settling ponds approximately 200' x 60' x 15' deep each (0.5 acre total), water diversion for a wash plant, and in extreme cases the streams might be diverted into alternate channels so that the stream channel can be mined following issuance of the necessary State permits. Approximately 0.5 acre would be needed for stockpiling overburden and topsoil to be used during site reclamation. Therefore, it is anticipated that the total disturbed area would involve approximately 7.5 acres for a bench placer mining operation.

Lode Mine

Mining operations at a hydrothermal gold deposit in the planning area will involve stripping of large amounts of overburden comprised not only of soil, but waste rock. Due to steep terrain, it is expected that the stockpile site for this material will be at a distance where the overburden will have to be hauled by truck and unloaded rather than pushed aside by bulldozer. Drilling, blasting and crushing the gold ore will be conducted at the site.

Surface Impacts of Lode Mine Development

The mine excavation area is anticipated to involve the disturbance of about 10 acres. It is anticipated that approximately two acres will be needed to stockpile overburden and topsoil near the mined area. Approximately two acres will be needed for support facilities and a staging area, and new haul roads would be needed, involving the disturbance of about two acres. Therefore, approximately 16 acres would be impacted

by this lode mine development. Mineral processing is anticipated to be conducted elsewhere due to the steep topography.

Recreational Mining

Most recreational mining operations on BLM lands in the planning area are anticipated to utilize hand tools or portable suction dredges. Many of the recreational mining operations are expected to be conducted on mining claims in the Cow Creek drainage. Some recreational mining may also occur at the Cow Creek Recreation Site or at other locations throughout the District where casual use-level mineral specimen collecting has occurred. In situations where either camping (in excess of 14 days) or the use of motorized equipment is proposed, a Notice will be required of the operator.

In-stream dredging is usually a one to two person operation using a floating suction dredge with a five to seven horse power engine. The dredge pulls up all the gravel in the stream down to bedrock. The gravels are passed over a sluice box and are returned to the stream without the gold. This process does not require any chemicals. Most of the dredges have an intake nozzle opening of less than five inches diameter. The average stream area disturbed in any year is less than 1000 square feet per dredge operation, based on operations monitored in the past. Other activities associated with dredging include temporary occupancy and minor road and trail construction. It is predicted that 20 Notices will be filed for this type of mining activity.

Surface Impacts of Suction Dredging Operations

It is anticipated that approximately 0.15 acre would be disturbed by each in-stream suction dredging operation, and for each operation a camping area approximately 0.10 acre in size would be utilized. Therefore, during the plan period, the 20 anticipated Notices expected to be filed pertaining to these operations would affect a total of five acres of land.

It is anticipated that hobby mineral collecting and rockhounding will take place on the BLM lands in the operating area, however the surface impacts of those operations are presumed to be negligible since the mineral collectors most often use existing roads and look for surface geologic exposures. Any excavation of specimens is generally conducted with hand tools and is considered casual use.

Salable Mineral Resources – Reasonably Foreseeable Development Scenarios

Future Trends and Assumptions

It is anticipated that the public will continue to request the use of mineral materials from quarry sites located on the District. When possible, the use of existing sources is preferred, however new site development is not precluded in this plan.

Development of Salable Mineral Resources

The quality and quantity of the mineral materials available at a given site are important factors in the decision of whether or not a source is used by either the public or government agencies. The site location and distance to the point of use is another important consideration.

Surface Impacts of Quarry Development

All Alternatives

It is expected that two new quarry sites will be developed in the operating area during the plan period. On the average, each new site is expected to disturb approximately two acres of land. This acreage will be developed for use as a rock crushing operating area, truck turn around, access trails for bulldozers and drills, overburden stockpile sites, and aggregate stockpile areas. For access to a new quarry site, approximately one-half acre of land will be disturbed by new road construction, most often affiliated with a timber sale contract. Therefore, it is anticipated that approximately five acres would be impacted by new quarry site development.

It is expected that the 60 existing quarry sites on this district will be utilized and possibly expanded during the plan period. Probably no more than ten percent of these sites would be expanded over the course of the plan period, and these expansions most likely would be less than two acres. In some cases, new vehicle access must be constructed to allow for such expansion and when this is the case, roughly one-tenth of an

acre per site would be involved. Approximately 20 acres may be impacted by quarry site expansion under these alternatives.

It is expected that two of the existing quarry sites would be depleted in the operating area during the plan period. After all useable rock is removed, reclamation work would be conducted according to an approved interdisciplinary plan.

Appendix 4-4
Soil Compaction, Erosion, and Nutrient Status

Soil disturbance usually is an unavoidable consequence of most management activities. The district's soils differ in their degree of sensitivity to disturbances. The type and magnitude of disturbance determine the effects on soil productivity. Timber management practices, including road construction, are the dominant management activities which create disturbances (compaction/displacement, surface erosion, mass wasting, and alteration of nutrient status).

Compaction/Displacement

Soil compaction is the process where soil pore space is reduced because of physical pressure and vibration exerted on the soil surface. Compaction results in reduced plant growth due to reduced water infiltration, and gaseous and nutrient exchange rates. Physical resistance to root growth can occur with high soil densities. Compaction may also affect populations of soil organisms, but resultant tree growth impact is unknown.

Soil displacement is a process where a portion or all of the surface soil is moved by mechanical action. This may affect plant growth, depending on distance moved, by removing nutrients and soil organisms, and by reducing available water and rooting depth.

Timber harvest and site preparation methods together with soil conditions during operation influence the degree of soil compaction and displacement. The yarding system utilized during harvest affects the amount of soil disturbed. Amount of compaction/displacement created by ground-based yarding primarily depends on areal extent of yarding trails, soil moisture during yarding, number of passes over each trail, and amelioration practices used.

Amount of soil compaction/displacement and tree growth losses created by mechanical site preparation vary with differing conditions (amount of material to be piled, soil moisture, machine type and operation, depth of organic matter layers, number of machine passes, etc.). The more a log is suspended during yarding with a cable system, the less the soils are disturbed, thus skyline systems generally disrupt less than highlead systems (Dyrness 1967). Hi-lead systems may disturb from 15-20 percent of the harvested area (Dyrness 1967, Sidle 1980). Skyline systems generally disturb less than 10 percent of the area, and aerial systems affect less than five percent of the ground (Dyrness 1967). Compaction, displacement, and mixing are the primary yarding disturbances. The significance of displacement and mixing of surface soils and organic materials on long term productivity is unknown. Cable yarding compaction growth effects are unknown.

The areal extent of detrimental soil compaction/displacement created by ground-based yarding can be minimized by utilizing designated skid trails that are restricted to a predetermined percentage of the harvest unit (Froehlich, et. al. 1981; Garland, 1982; BLM Compaction Guidelines, 1983). Detrimental soil compaction created by mechanical site preparation can be minimized or avoided by utilizing a tracked excavator and limiting the number of passes to two (forward and back) when soils are dry and most resistant to compaction. Tillage can fracture and ameliorate compacted soil. The degree of fracturing varies with tillage equipment, machine operation, and soil or site conditions (texture, moisture, coarse fragment content, etc.) Andrus and Froehlich (1983) reported fracturing of approximately 80 percent for properly designed winged rippers. Davis (1990) reported bulk densities of compacted areas tilled with a self-drafting winged subsoiler were not significantly different than those in uncompacted areas.

Although soil structure and pores are not returned to their natural condition by tillage, it is commonly accepted that tillage increases productivity of compacted soils. No research has been conducted that correlates the degree of fracturing and restoration of soil density with a similar degree of growth potential restoration.

Soil Erosion and Mass Wasting (Landsliding)

Surface erosion and mass wasting are two types of soil erosion that affect long term productivity of forest soils. Both are naturally occurring geologic processes involving gravity, soil water, precipitation events, etc.

Surface soil erosion, which includes sheet, rill, gully, and dry ravelling, is the detachment and movement of individual soil particles or aggregates downslope. It is caused either by the energy of rainfall and running water acting on bare soils, or by surface disturbance of steep slopes. In some of the higher elevation areas, freezing and thawing, especially on a daily basis, can

cause considerable erosion on disturbed ground. This is particularly apparent in road cutbanks and areas with exposed soil.

Mass wasting (landsliding) is the downslope movement of soil and rock material. Volume of mass wasting events can range from a few cubic feet to thousands of cubic yards. Some of the more important factors that contribute to soil/slope instability are steep gradient, low soil strength, declining root strength, shallow soil depth, road construction, and a high frequency, long duration, and intense precipitation.

Several distinct types of mass movement are recognized. Debris avalanches and debris torrents are similar in that both occur on steep slopes, are fast moving, and are composed of soil, rock, water, and organic material. Torrents are water charged and occur in drainages, whereas avalanches lack the high water content and may or may not occur in drainages. These are the most dangerous types of landsliding and usually produce the most dramatic on-site and off-site effects. Various slow moving types of mass movement such as shallow earth flows, rotational slumps, and deep-seated geologic events occur and are usually initiated by excessive water. Major concerns and impacts of mass wasting are public safety, private property, roads, bridges, water quality, and fisheries (see Chapter 4, Water Resources and Fish sections). Current, state-of-the-art road construction practices have dramatically reduced the landslide frequency rate from that of pre-1975 road construction practices.

Reduction in root strength following timber harvest and site preparation activities is possibly a significant cause of landsliding outside the area of road construction. These changes match the high frequency of landslides the first few years following timber harvest on slopes with high potential for failure in Western Oregon (Burroughs and Thomas 1977). Areas most sensitive to loss of root strength and subsequent translational-type (slip surface is relatively shallow, planar, and roughly parallel to the ground surface) landsliding usually are steep (70 percent +) slopes in concave positions over hard bedrock in areas of high rainfall. Rotational- type (slip surface is relatively deep and circular) landslides are less sensitive to the root strength factor but are sensitive to disturbances to soil and ground water and natural slope configuration.

Nutrient Status

Soil organic matter accumulation and cycling are related to site index. When compared to lower site indices, higher sites have more organic matter incorporated into the soil and a larger nitrogen pool. Therefore, productivity is usually more resilient on higher sites. For maintenance of long-term productivity, conservation of organic matter on low sites is more important than on high sites.

Harvest and site preparation intensities and frequencies influence the amount and composition of the surface organic layer. Conservation of small materials (needles, leaves, twigs) is important for site total nitrogen because these materials have the highest concentrations of nitrogen. When compared to needles and twigs, removal of large materials (stemwood and large branches) has less effect on site total nitrogen. However, the large materials are important for continuation of healthy symbiotic fungi populations (Maser etal 1978).

Appendix 4-5
Results of Watershed Condition Index; Analytical Watershed by Alternative

Figure 4-5-1. Myrtle Creek Analytical Watershed Watershed Condition Index by Alternative - Current vs. Ten-Year

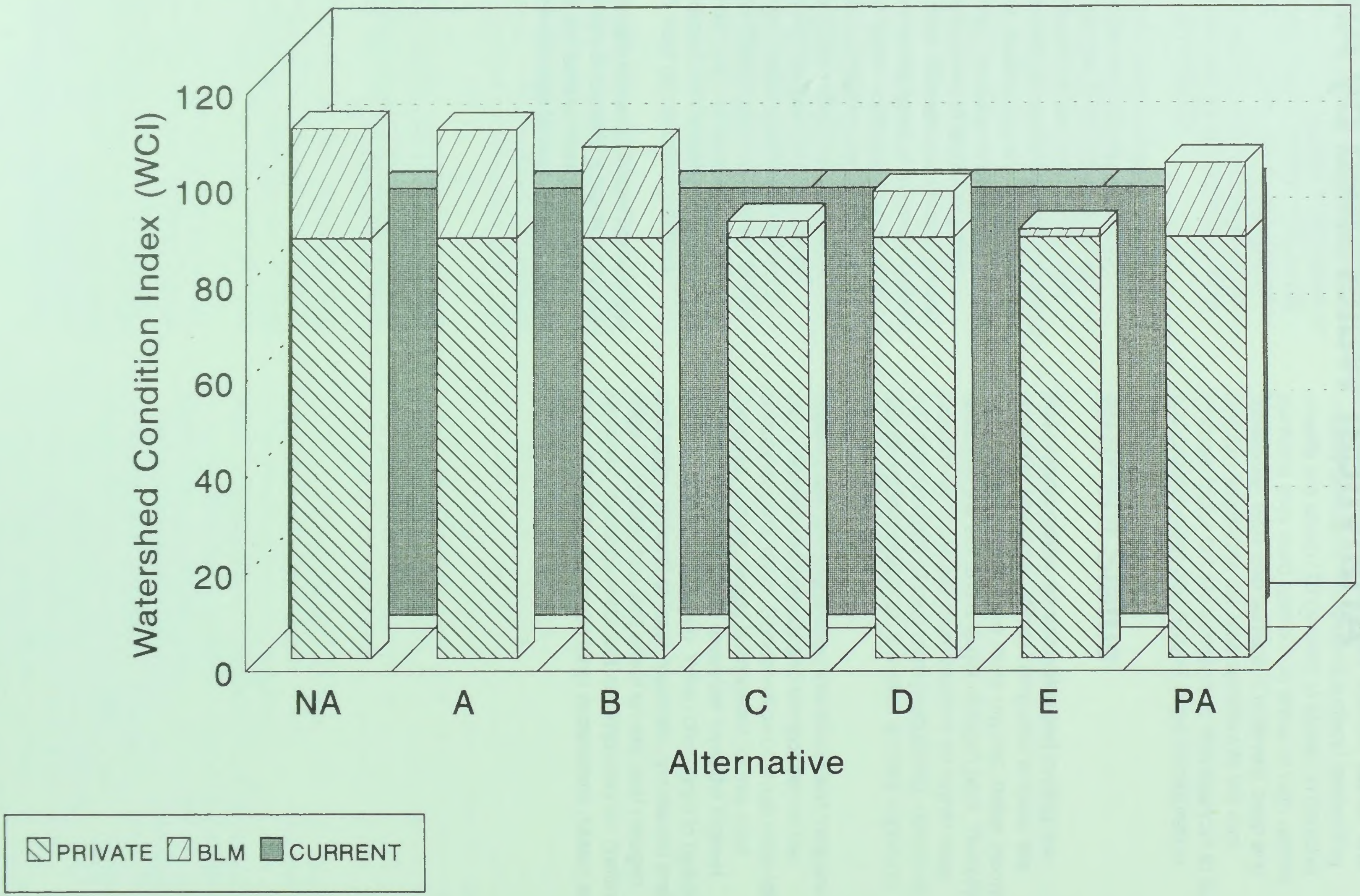


Figure 4-5-2. Upper South Umpqua Analytical Watershed Watershed Condition Index by Alternative - Current vs. Ten-Year

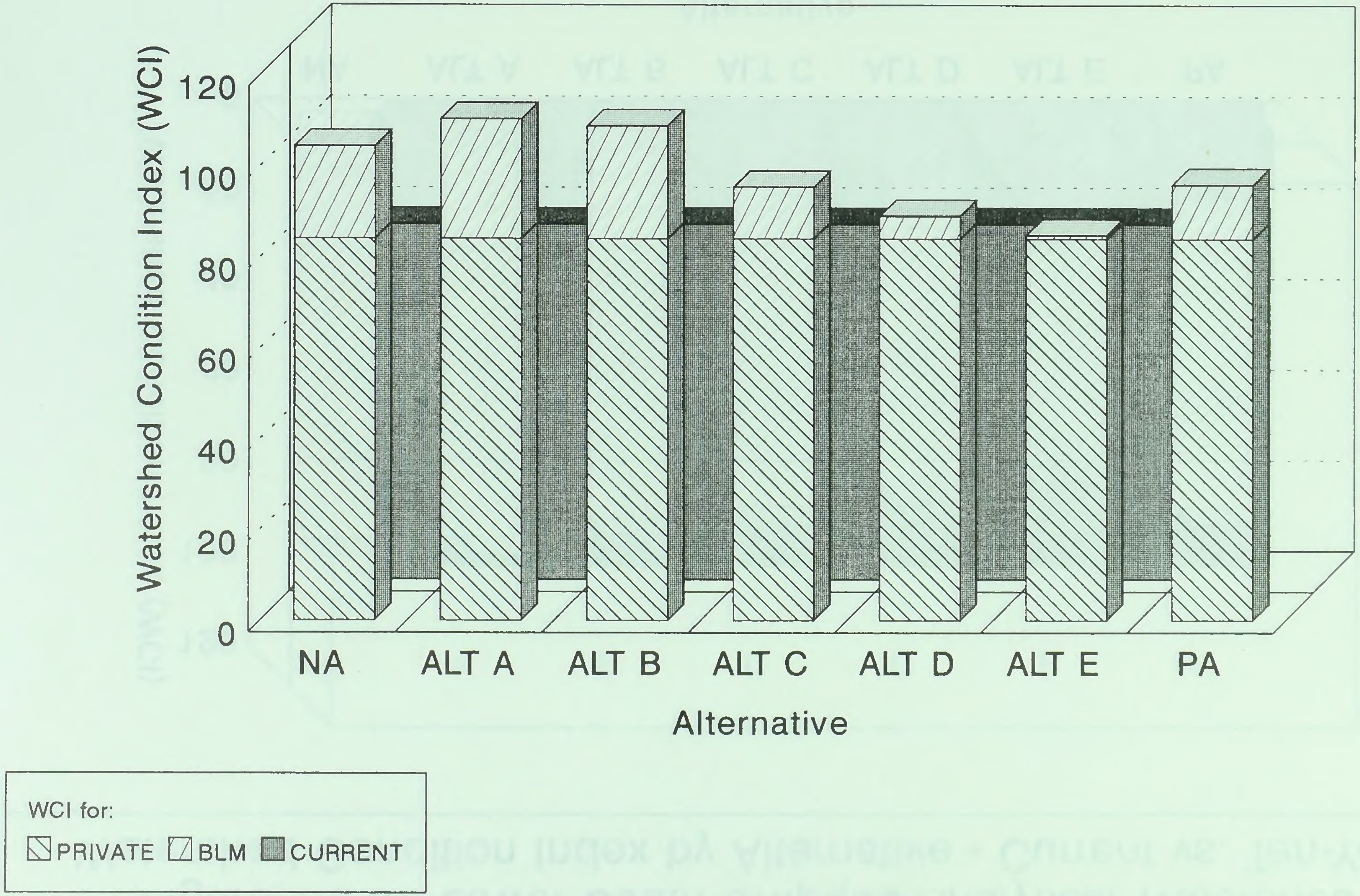


Figure 4-5-3. Lower South Umpqua Analytical Watershed Watershed Condition Index by Alternative - Current vs. Ten-Year

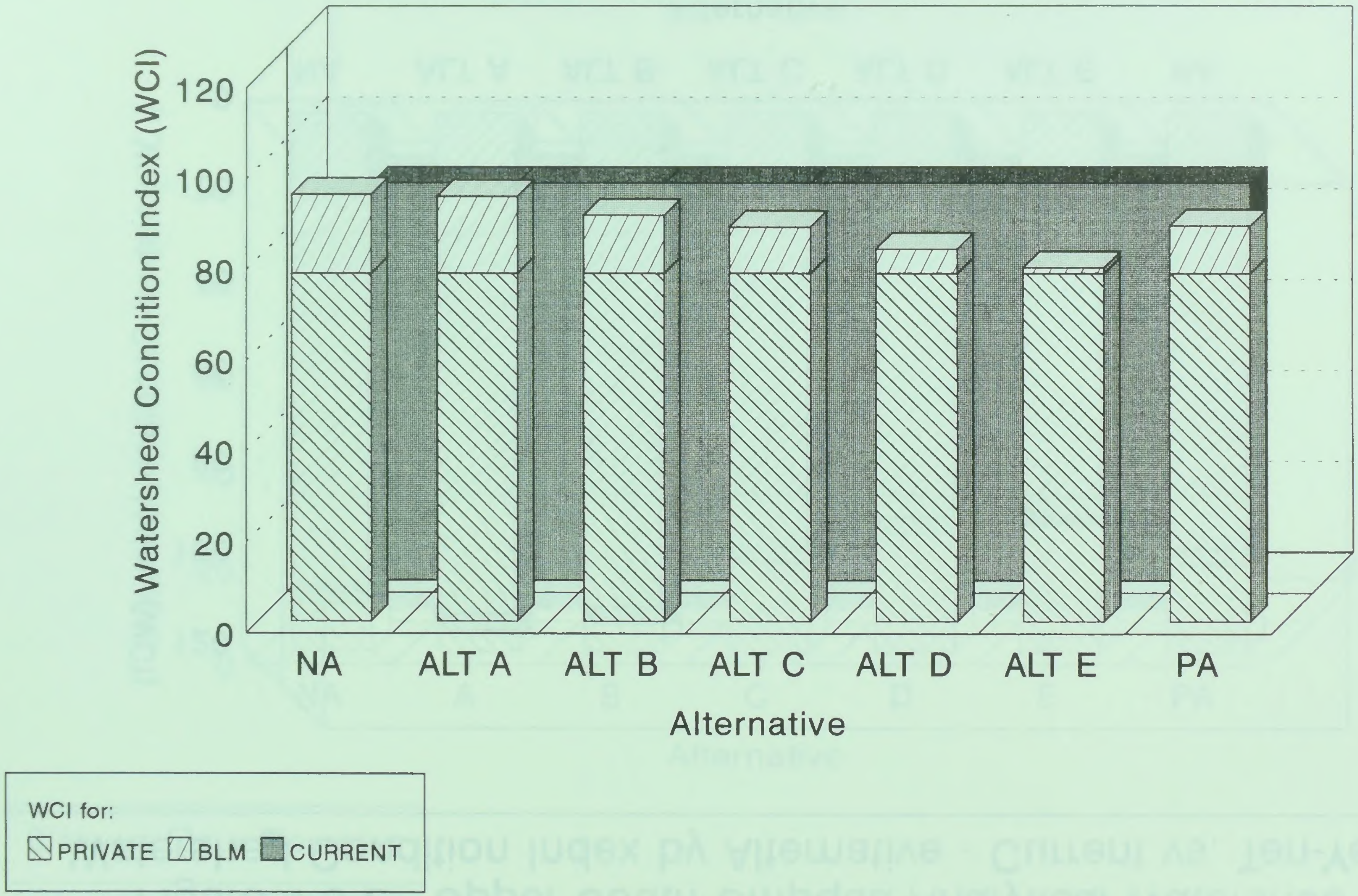


Figure 4-5-4. Cow Creek Analytical Watershed Watershed Condition Index by Alternative - Current vs. Ten-Year

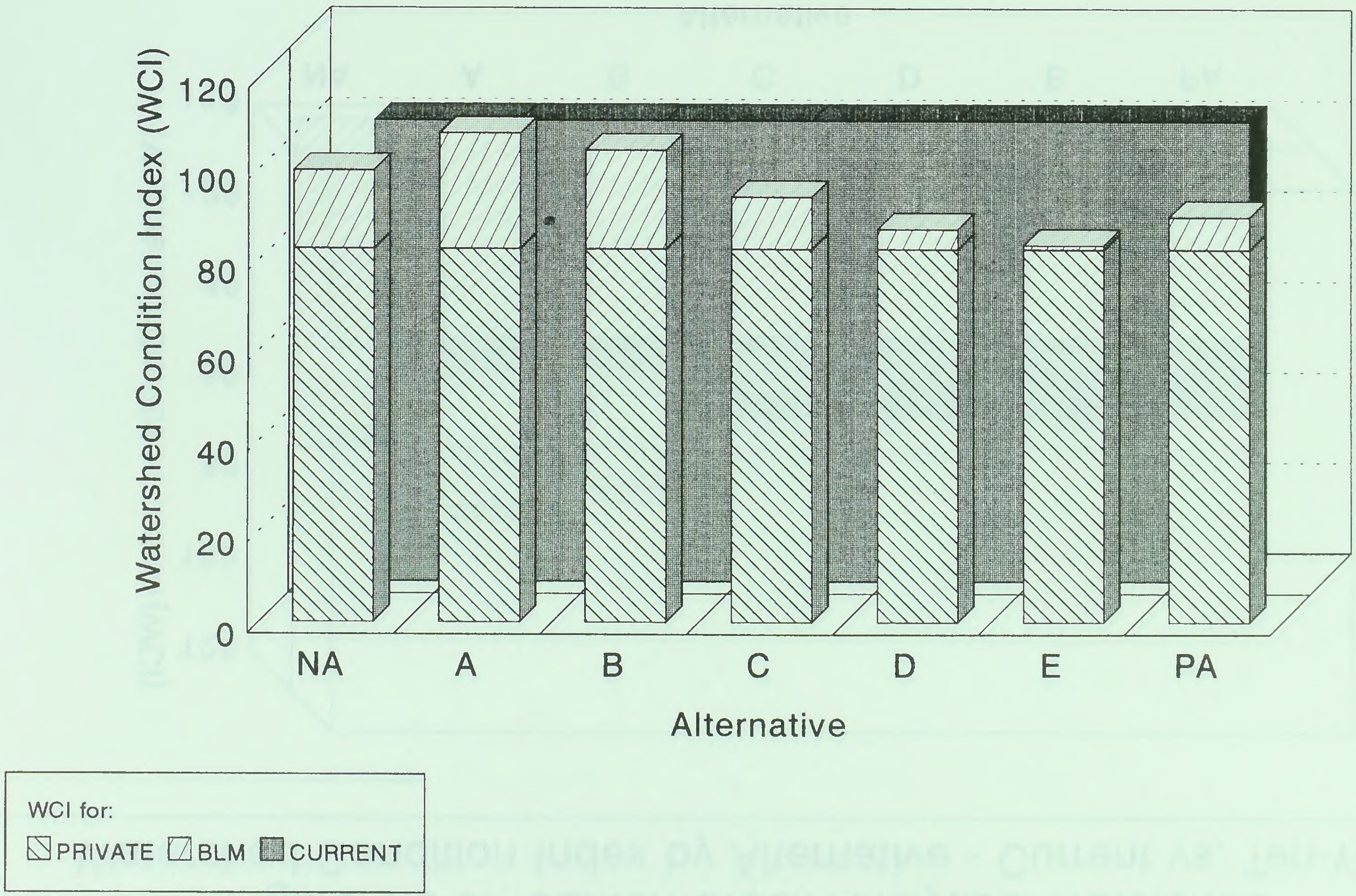


Figure 4-5-5. Canton Creek Analytical Watershed Watershed Condition Index by Alternative - Current vs. Ten-Year

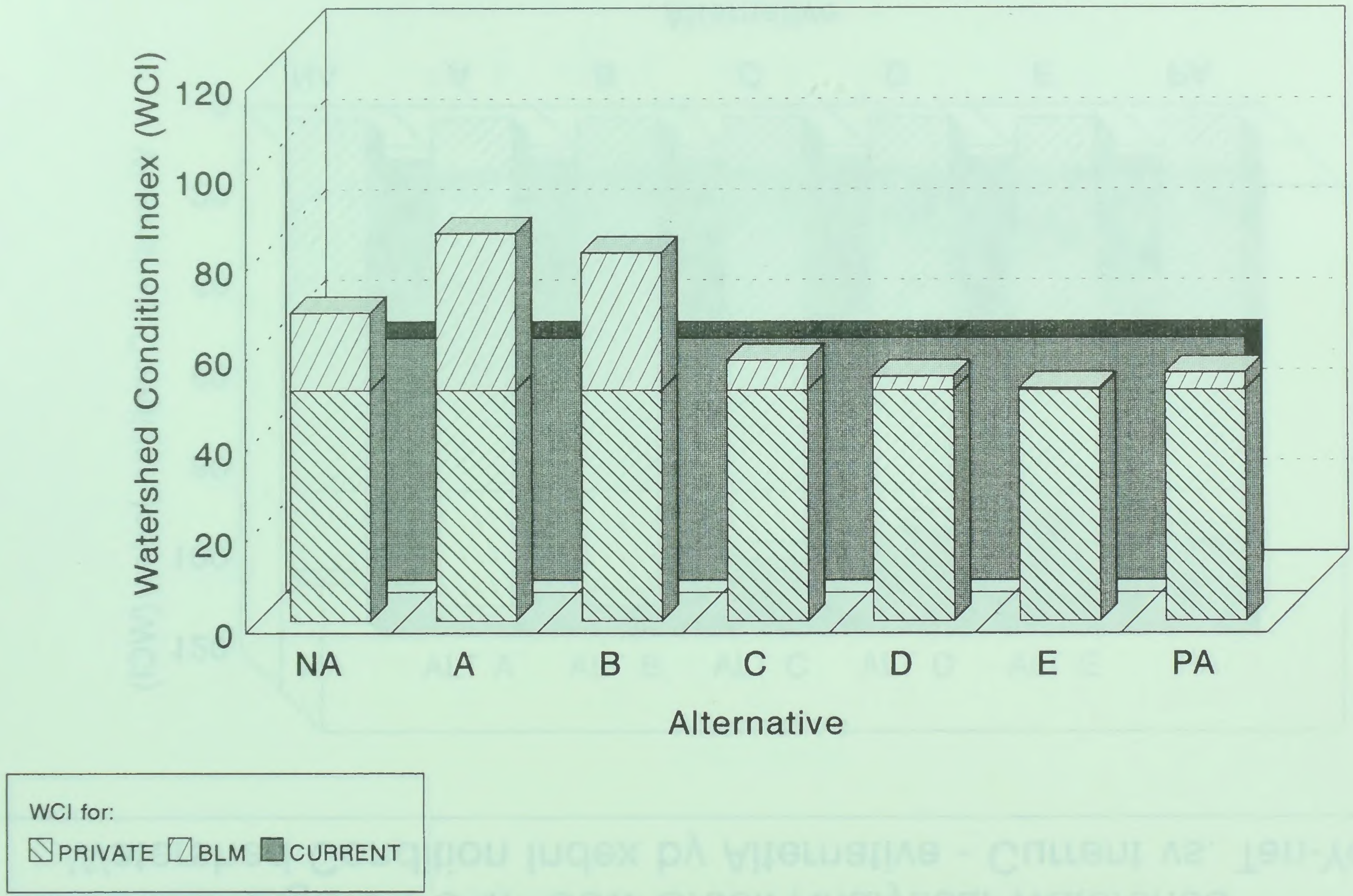


Figure 4-5-6. Little River Analytical Watershed Watershed Condition Index by Alternative - Current vs. Ten-Year

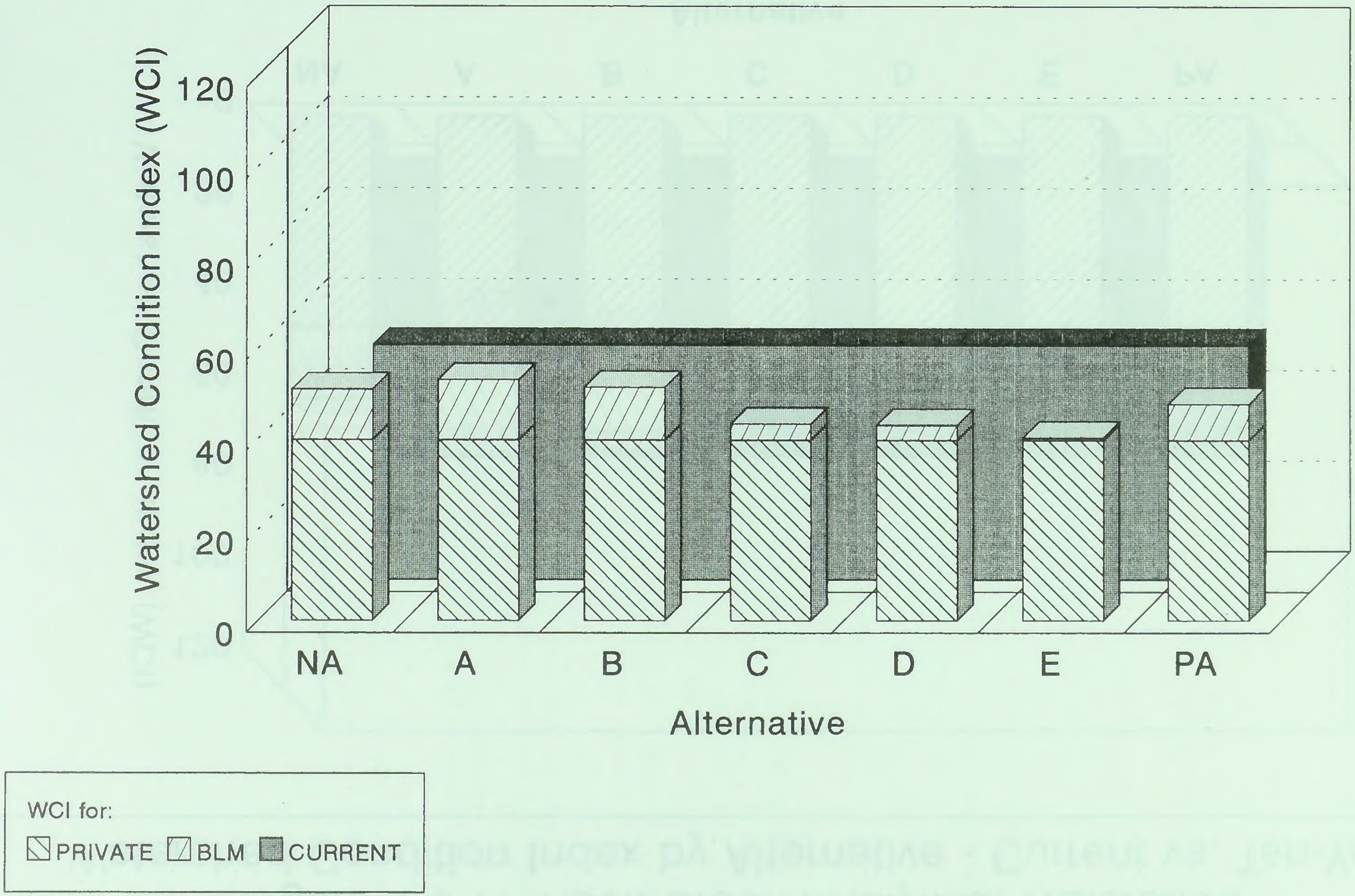


Figure 4-5-7. Rock Creek Analytical Watershed Watershed Condition Index by Alternative - Current vs. Ten-Year

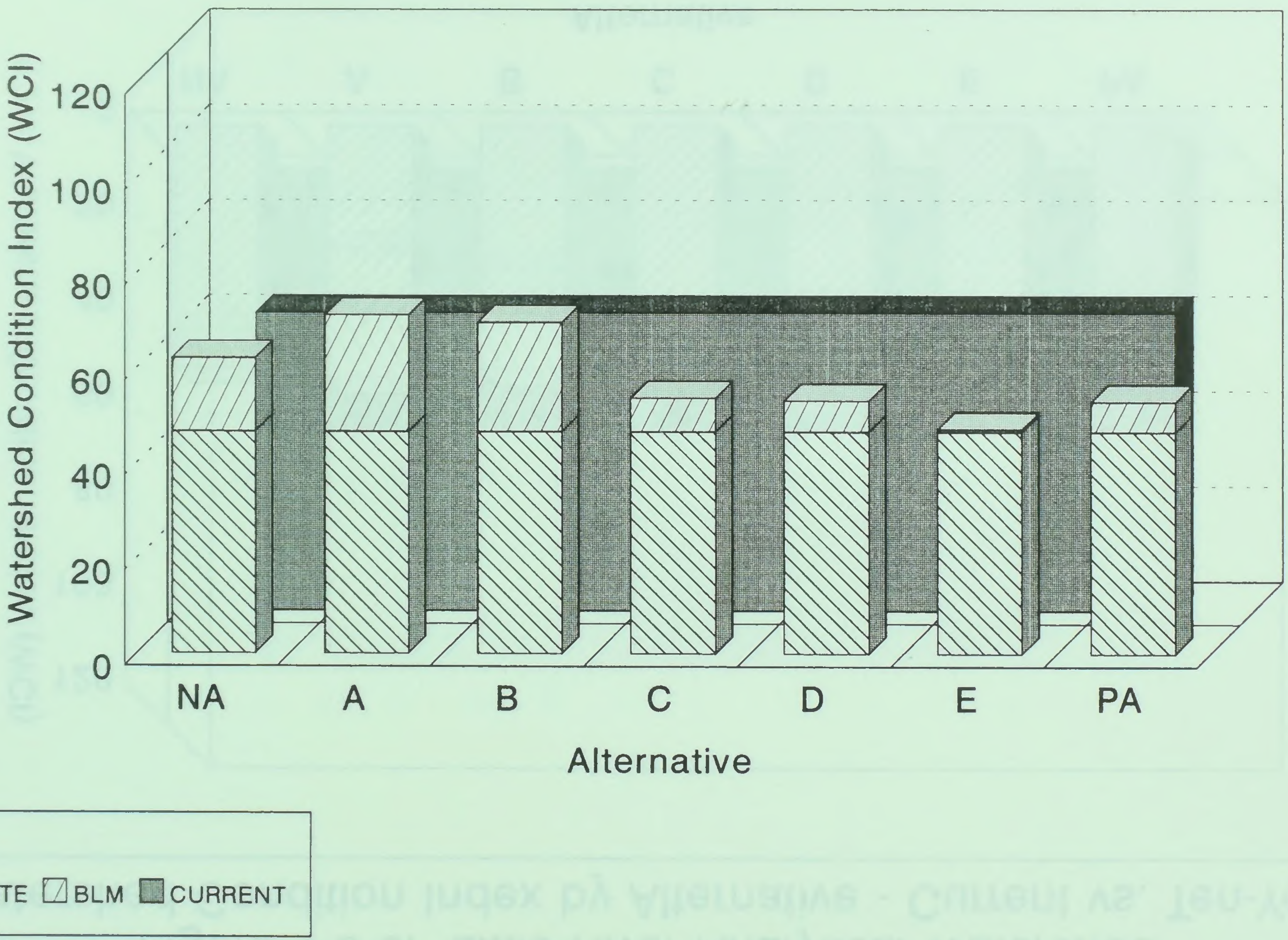


Figure 4-5-8. Upper Umpqua Frontal Analytical Watershed Watershed Condition Index by Alternative - Current vs. Ten-Year

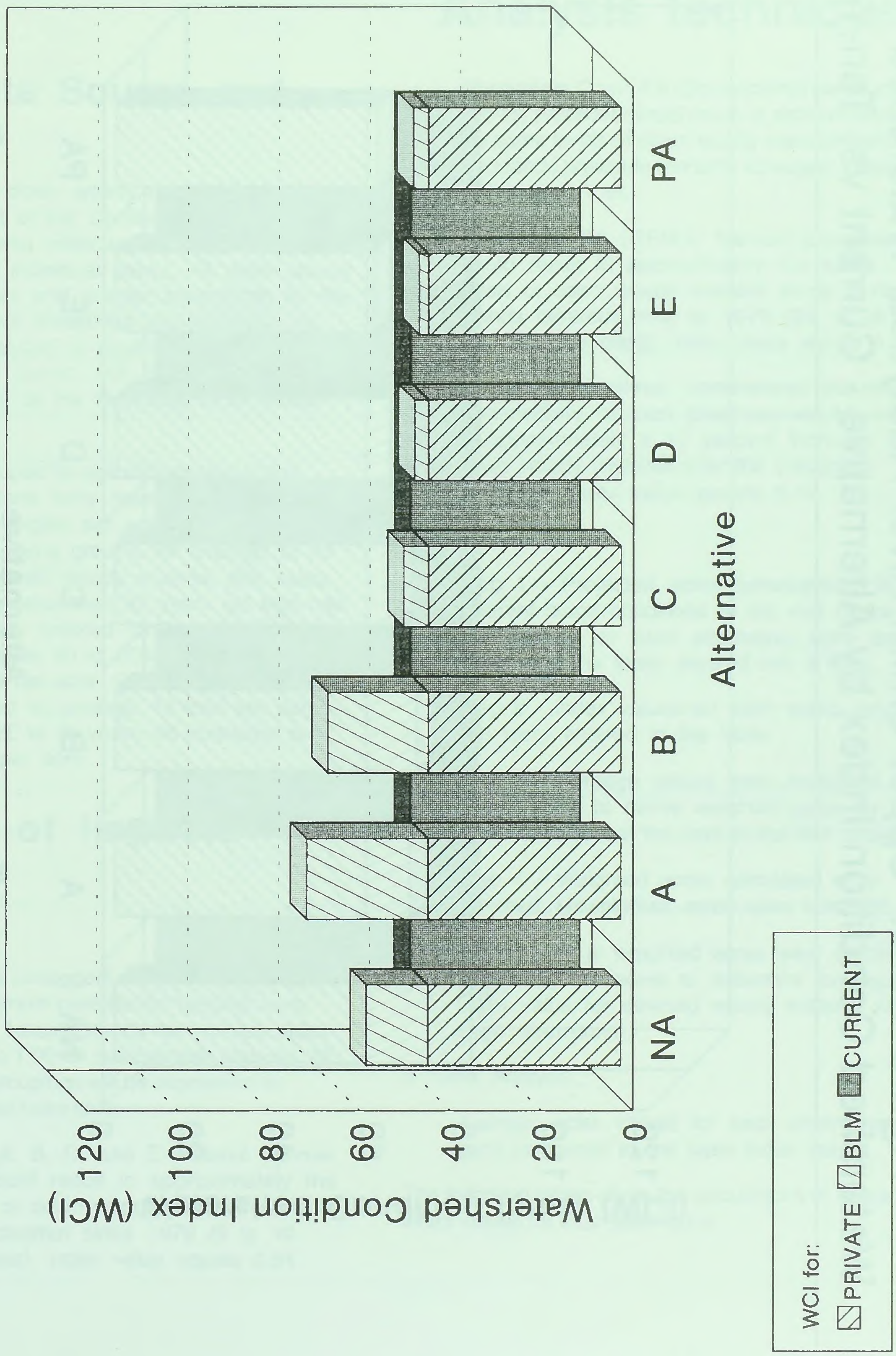
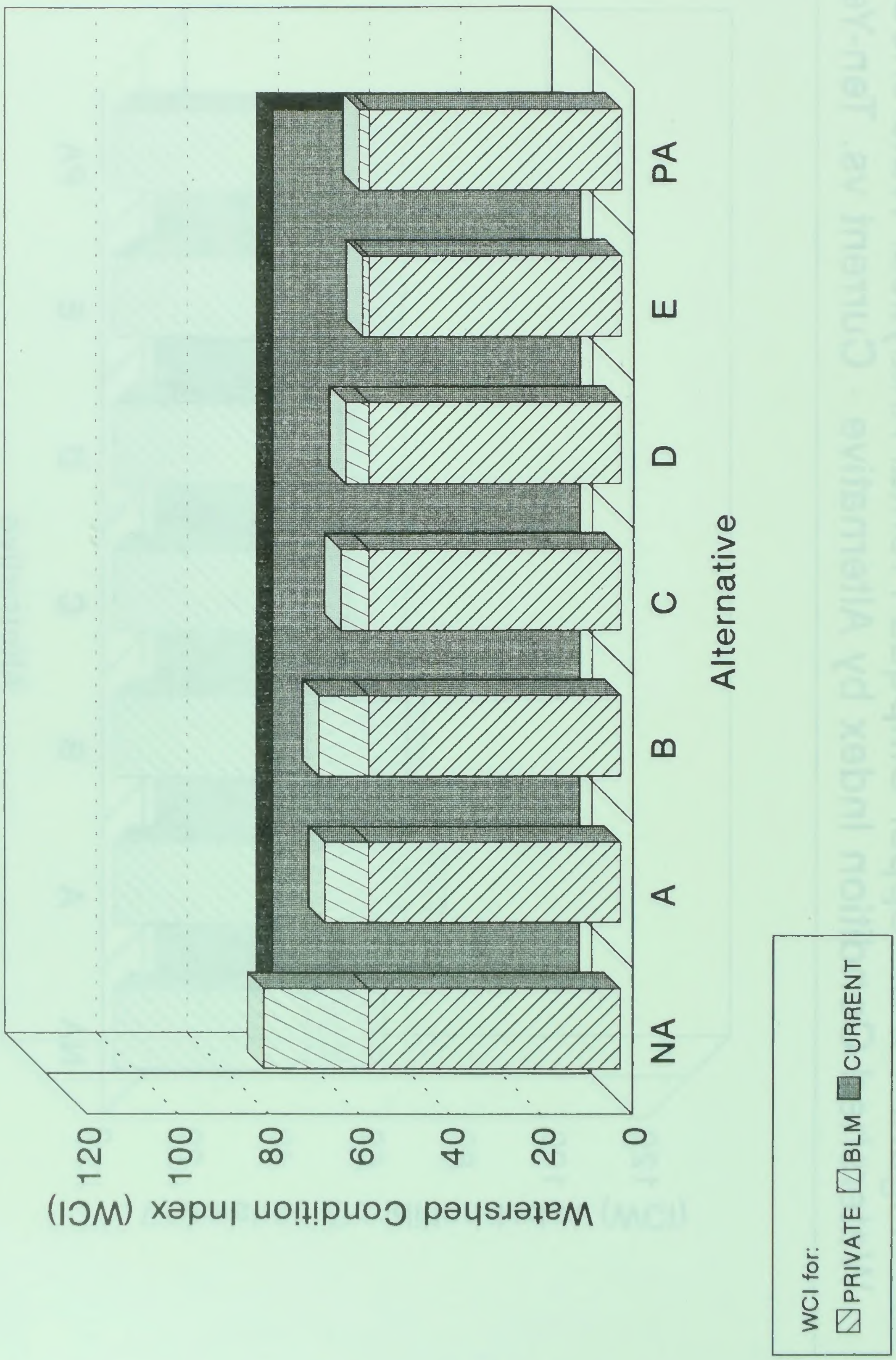


Figure 4-5-9. Upper Smith River Analytical Watershed Watershed Condition Index by Alternative - Current vs. Ten-Year



Appendix 4-6
Dead and Down Woody Material Analysis Techniques

Basic Data Source and Analysis

Measurements of down woody material were conducted as part of the Continuous Forest Inventory (CFI). Data was collected on transects located between CFI plot individual points. All down woody material 7.0 inches and greater intersected by the transect plane were measured and recorded. All plot data was analyzed to determine present conditions on the district. Full details of these analyses is on file at the Roseburg BLM district office.

CFI plots were grouped by age classes and stand histories. Calculations were made of the average tons, pieces, and lengths per acre of down woody material by these stand groups. An average of 23 tons per acre of down woody material was calculated for stands greater than 40 years old that had not been previously entered for harvest. For unlogged stands ages 40 to 200+ years the range was 14 to 25 tons per acre. Stands aged 5 to 10 years old contained an average 19 tons per acre and stands aged 20 to 30 years old contained an average 29 tons per acre.

Analysis of Impacts Technique

1. Assumptions

   Natual stands (unlogged) on the average represent the maximum potential for species using downed logs. Natural stands have a base index value equal to 1.00 for down woody material. All other stand groupings will be expressed as function of that base level.

   Alternatives A, B, D, and E clearcut harvest practices would result in approximately the same levels of down woody material found in the stands clearcut since 1970 (5 to 10 year age class); index value equals 0.84.

   Alternatives C and PA (Connectivity) partial cut harvest practices would result in approximately the same levels of down woody material found in the stands previouly mortality salvaged; index value equals 1.46.

   Alternative PA (GFMA) harvest practices would result in approximately the same levels of down woody material found in the stands clearcut prior to 1970 (20 to 30 year old age class); index value equals 1.29.

   For all alternatives, commercial thinning/ intermediate harvest practices would result in approximately a 10 percent increase in down woody material over the unlogged condition; index value equals 1.10.

2. Data Development

   Step 1 - Projected acres (unweighted) in different stand conditions at the end of the first decade for each alternative were determined and the totals entered into a table.

   Step 2 - Index values for each stand condition were entered in the table.

   Step 3 - Acreage values were multiplied by index values to derive weighted acres by stand condition at the end of the first decade.

   Step 4 - Weighted acres calculated were summed. Unweighted acres were summed.

   Step 5 - Total weighted acres were divided by unweighted acres to determine average index value for downed woody material for each alternative.

3. Data Analysis

   Average index values for each alternative were compared to the base index values.

The following tables show the calculations of average index values for each alternative.

Table 4-6-1 Down Wood Analysis for Existing Condition

Category	Acres	Index	Col 2 * 3
Unlogged	237,800	1.00	237,800
Comm. Thinned	1,900	1.10	2,090
Mort. Salv.	6,172	1.46	9,011
Partial Cut	0	0.00	0
Clearcut < 1970	66,535	1.29	85,830
Clearcut 1970-1990	71,976	0.84	60,460
Clearcut >1990	0	0.00	0
	384,383	**1.03**	**395,191**

Based on District Empiric Date from CFI plots
which show average unlogged condition to be
23 tons per acre not 60 as shwon in SD Guidance.
Factor 1.00 = 23 tons/acre
Unlogged includes age classes 40-200+

Table 4-6-2 Down Wood Analysis for Alternative A

Category	Acres	Index	Col 2 * 3
Unlogged	162,100	1.00	162,100
Comm. Thinned	3,600	1.10	3,960
Mort. Salv.	6,172	1.46	9,011
Partial Cut	0	1.46	0
Clearcut < 1970	66,535	1.29	85,830
Clearcut 1970-1990	71,976	0.84	60,460
Clearcut >1990	74,000	0.84	62,160
	384,383	**1.00**	**383,521**

Table 4-6-3 Down Wood Analysis for Alternative B*

Category	Acres	Index	Col 2 * 3
Unlogged	169,600	1.00	169,600
Comm. Thinned	3,500	1.10	3,850
Mort. Salv.	6,172	1.46	9,011
Partial Cut	0	1.46	0
Clearcut < 1970	66,535	1.29	85,830
Clearcut 1970-1990	71,976	0.84	60,460
Clearcut >1990	66,600	0.84	55,944
	384,383	**1.00**	**384,695**

Table 4-6-4 Down Wood Analysis for Alternative C*

Category	Acres	Index	Col 2 * 3
Unlogged	200,000	1.00	200,000
Comm. Thinned	7,300	1.10	8,030
Mort. Salv.	6,172	1.46	q,011
Partial Cut	32,400	1.46	47,304
Clearcut < 1970	66,535	1.29	85,830
Clearcut 1970-1990	71,976	0.84	60,460
Clearcut >1990	0	0.84	0
	384,383	**1.07**	**410,635**

Table 4-6-5 Down Wood Analysis for Alternative D*

Category	Acres	Index	Col 2 * 3
Unlogged	222,900	1.00	222,900
Comm. Thinned	2,900	1.10	3,190
Mort. Salv.	6,172	1.46	9,011
Partial Cut	0	1.46	0
Clearcut < 1970	66,535	1.29	85,830
Clearcut 1970-1990	71,976	0.84	60,460
Clearcut >1990	13,900	0.84	11,676
	384,383	**1.02**	**393,067**

Table 4-6-6 Down Wood Analysis for Alternative E*

Category	Acres	Index	Col 2 * 3
Unlogged	231,100	1.00	231,100
Comm. Thinned	1,900	1.10	2,090
Mort. Salv.	6,172	1.46	9,011
Partial Cut	0	1.46	0
Clearcut < 1970	66,535	1.29	85,830
Clearcut 1970-1990	71,976	0.84	60,460
Clearcut >1990	6,700	0.84	5,628
	384,383	**1.03**	**394,119**

Table 4-6-7 Down Wood Analysis for Alternative PA

Category	Acres	Index	Col 2 * 3
Unlogged	203,048	1.00	203,048
Comm. Thinned	3,237	1.10	3,561
Mort. Salv.	6,172	1.46	9,011
Connectivity	10,741	1.46	15,682
Clearcut < 1970	66,535	1.29	85,830
Clearcut 1970-1990	71,976	0.84	60,460
GFMA	22,674	1.29	29,249

Table 4-6-8 Down Wood Analysis for Alternative NA

Category	Acres	Index	Col 2 * 3
Unlogged	179,400	1.00	179,400
Comm. Thinned	3,300	1.10	3,630
Mort. Salv.	6,172	1.46	9,011
Partial Cut	0	0.00	0
Clearcut < 1970	66,535	1.29	85,830
Clearcut 1970-1990	71,976	0.84	60,460
Clearcut >1990	57,000	0.84	47,880
	384,383	**1.00**	**386,211**

Appendix 4-7
Analytical Methods for Assessing Impacts on Wildlife Habitat and Populations

Roosevelt Elk

Assessment Method

Wisdom et al., A Model to Evaluate ELk Habitat in Western Oregon (modified)

Note to Reader: The Widsom Model is modified to reflect the scale of planning at the forestwide level. The major modification is to drop the spacing index (HEs). The HE_r index will be calculated for both BLM and non-BLM lands within the analysis areas, but the HE_c and HE_f indicates will be calculated only for BLM lands due to the lack of vegetation data for non-BLM lands.

Assumptions/Comments:

1. Evaluations will be conducted for each elk management area with substantial existing or potential elk use and where BLM has at least 25percent ownership.

2. See wisdom et al. (p 11) for a complete list of assumptions pertinent to use of the model.

3. Use the following forest stages as a guide:

Forage areas	=	0-20 years.
Hiding cover	=	21=50 years with appropriate stocking classes.
Thermal cover	=	51-160 years with appropriate stocking classes.
Optimal cover	=	160+ years with appropriate stocking classes.

Analytical Techniques:

1. Road Density (HE_r):

   a. Determine miles of drivable roads within each elk management area for the existing condition. Divide miles of road by acres of WODDB coverage within each area to determine road density. Compare density to the desired 1.5 mile benchmark recommended in the ODFW Forest Habitat Protection Criteria for BLM lands (1990).

   b. Estimate shifts in HE_r within each analysis area by reference to the 10 Year Timber Harvest Scenario (i.e., determine proposed road construction levels over the next decade and project a positive, negative or neutral change in road density).

   c. Write narrative to predict long-term impacts (100 years) of road construction on elk for BLM and non-BLM administered lands.

2. Cover Quality (HE_c):

   a. Determine the amount of optimal (0) thermal cover, thermal (T) cover, and hiding (H) cover. Individual OI polygons have already been tagged with the above codes (i.e., O, T, H) based on stand age. Calculate HE_c according to Wisdom Mode. Calculate percent optimal thermal cover, percent thermal cover, and percent hiding cover, in ara and compare to ODFW benchmarks (Forest Habitat Protection Criteria for BLM lands).

   b. Estimate shifts in HE_c within each analysis area by reference to the 10 Year Timber Harvest Scenario and display as a positive, negative or neutral changes in cover quality conditions.

   c. Write narrative to predict long-term impacts (100 years) on HE_c and cover percentages for BLM lands.

3. Forage Quality (HE_f):

   a. Use HE_f attribute in FOI theme to determine acres of forage by quality classes as described in Wisdom Model (p. 29)

   b. Calculate existing HE_f index according to Wisdom Model.

   c. Estimate shifts in HE_f within each analysis area by reference to the 10 Year Harvest Scenario and display as a positive, negative or neutral change in forage quality conditions.

d. Write narrative to predict long-term impacts (100 years) on HE_f for BLM lands.

Display Techniques:

Display road density, cover, and forage/HE_r, HE_f, HE_c, indices for each elk management area for existing condition. Use +/- techniques to evaluate changes of indices based on comparisons with 10 Year Timber Harvest Scenario and proposed road closures.

Dominant Woodpeckers

Assessment Method

Neitro et al. method to analyze multiple species snag requirements (described in Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington edited by E. Read Brown, 1985).

Assumptions:

1. By managing for dominant woodpeckers, requirements of other cavity users will be fulfilled.
2. A direct correlation exists between snag densities and population densities of cavity users.
3. The following minimum guidelines have been established for all alternatives.

   Wildlife trees (snags) will be greater than 20" dbh and at least 15 feet tall; green trees retained will generally be 20" dbh or greater with minimum tree size being 15" dbh.

   Leave all soft snags except where they are unacceptable for safety, logging systems, or burning considerations.

Analytical Techniques:

1. Estimate existing snag levels for each forest age class. These snag levels were estimated from projections of snag densities currently being measures on timber inventory plots. Snag densities were determined for the following conifer age classes: 1-30, 40-80, 90-190, and 200+.2.
2. Snag densities for each age class for the range of alternatives were determined using the ORGANON model to generate snag recruitment from suppression mortality and green tree retension mortality. Snag recruitment was then entered into the Marcot Snag Model to predict snag abundance over time.
3. Snags densities were determine for each stand age class for the current, short term (10 years) and long term (100 years) conditions. The number of snags in each age class was then weighed by the percent of forested acres in the age class to arrive at an average number of snag per acre for the District.
4. Convert calculate snag densities into districtwide estimates of potential population levels (i.e., percent of maximum population levels) of dominant woodpeckers for each alternative (see Neitro et al., p. 145).
5. In narrative form, discuss specific and cumulative effects of the alternatives on dominant woodpeckers and cavity users.

Display Techniques:

Display estimated population levels of dominant woodpeckers at end of 10 and 100 years.

Northern Spotted Owl: See Appendix 4-16, 4-17, 4-18, 4-19, and 4-20.

Appendix 4-8
Management Direction and Consequences of Managing Vivual Resources Under Each Alternative

Alternative	Management Direction/Consequences
NA	Downgraded areas would continue to be managed below inventory standards. Other areas would be managed at inventory standards.
VRM I	
	No acres of inventoried VRM I would continue to be managed as VRM IV.
	Over the next 10 years, approximately 0 acres of downgraded VRMI would be harvested under VRM IV standards.
VRM II	
	Approximately 69,300 acres of inventoried VRM II would continue to be managed as VRM IV.
	Over the next 10 years, approximately 10,700 acres of downgraded VRM II would be harvested under VRM IV standards.
VRM III	
	Approximately 5,000 acres of inventoried VRM III would continue to be managed as VRM IV.
	Over the next 10 years, approximately 800 acres of downgraded VRM III would be harvested under VRM IV standards.
A	25 acres would be upgraded from inventory classifications.
VRM I	
	No acres of inventoried VRM I would be downgraded to VRM IV.
	Over the next 10 years, approximately 0 acres of downgraded VRMI would be harvested under VRM IV standards.
VRM II	
	Approximately 63,500 acres of inventoried VRM II would be downgraded to VRM IV.
	Over the next 10 years, approximately 13,200 acres of downgraded VRM II would be harvested under VRM IV standards.
VRM III	
	Approximately 16,500 acres of inventoried VRM III would be downgraded to VRM IV.
	Over the next 10 years, approximately 3,400 acres of downgraded VRM III would be harvested under VRM IV standards.
B	25 acres would be upgraded from inventory classifications.
VRM I	
	No acres of inventoried VRM I would be downgraded to VRM IV.
	Over the next 10 years, approximately 0 acres of downgraded VRM I would be harvested under VRM IV standards.

Appendix 4-8 (cont.)

Alternative	Management Direction/Consequences
	VRM II
	Approximately 48,500 acres of inventoried VRM II would be downgraded to VRM IV.
	Over the next 10 years, approximately 8,900 acres of downgraded VRM II would be harvested under VRM IV standards
	VRM III
	Approximately 11,800 acres of inventoried VRM III would be downgraded to VRM IV.
	Over the next 10 years, approximately 2,200 acres of downgraded VRM III would be harvested under VRM IV standards.
C	25 acres would be upgraded from inventory classifications.
	VRM I
	No acres of inventoried VRM I would be downgraded to VRM IV.
	Over the next 10 years, no acres of downgraded VRM I would be harvested under VRM IV standards.
	VRM II
	Approximately 7,000 acres of inventoried VRM II would be downgraded to VRM III.
	Over the next 10 years, approximately 28,000 acres of VRM II would be downgraded to VRM IV standards.
	Over the next 10 years, approximately 3,200 acres of downgraded VRM II would be harvested under VRM IV standards.
	VRM III
	Approximately 11,100 acres of inventoried VRM III would be downgraded to VRM IV.
	Over the next 10 years, approximately 1,000 acres of downgraded VRM III would be harvested under VRM IV standards.
D	All acres would be managed as inventoried with one exception. Approximately 8500 acres of rural interface acres would be upgraded to VRM II.
	VRM I
	No acres would be harves
	VRM II
	Approximately 4,700 acres would be harvested to VRM II standards over the next 10 years.
	VRM III
	Approximately 1,200 acres would be harvested to VRM III standards over the next 10 years.

Appendix 4-8 (cont.)

Alternative	Management Direction/Consequences
E	All BLM land would be managed to VRM III standards or better.
VRM I	
	Inventoried VRM I would be neither downgraded nor harvested.
	Approximately 6,300 acres would be upgraded to VRM I.
VRM II	
	Inventoried VRM II would not be downgraded and therefore no VRM II would be managed at lower standards. Approximately 63,200 acres would be upgraded to VRM II for a total VRM II acreage of approximately 142,000 acres Approximately 2,500 acres would be harvested to VRM II standards over the next 10 years.
VRM III	
	Inventoried VRM III would not be downgraded and therefore no VRM III would be managed at lower standards.
	Approximately 253,400 acres would be upgraded to VRM III.
	Approximately 1,200 acres would be harvested to VRM III standards over the next 10 years.
PA	25 acres would be upgraded from inventory classifications.
VRM I	
	No acres of inventoried VRM I would be downgraded to VRM IV.
	Over the next 10 years, no acres of downgraded VRM I would be harvested under VRM IV standards.
VRM II	
	Approximately 7,000 acres of inventoried VRM II would be downgraded to VRM III.
	Over the next 10 years, approximately 28,000 acres of VRM II would be downgraded to VRM IV standards.
	Over the next 10 years, approximately 3,200 acres of downgraded VRM II would be harvested under VRM IV standards.
VRM III	
	Approximately 11,100 acres of inventoried VRM III would be downgraded to VRM IV.
	Over the next 10 years, approximately 1,000 acres of downgraded VRM III would be harvested under VRM IV standards.

Appendix 4-9
Volume and Acres Harvested by Age Class by Decade

Table 4-9-1 Volume (MMCF) Harvested by Age Class by Decade (Data corresponds to Figures 1-7)

Alternative NA

Age	Final Harvest MMCF 1st	MMCF 2nd	MMCF 3rd	MMCF 5th	MMCF 10th
30-39	0.0	0.0	0.0	0.0	0.0
40-49	0.0	0.0	0.0	0.0	0.0
50-59	0.0	0.0	2.6	197.0	163.5
60-79	0.0	0.0	86.8	109.9	139.4
80-99	0.0	0.0	70.2	0.0	0.0
100-199	15.0	273.8	166.8	0.0	0.0
200+	373.4	94.2	10.0	10.0	10.0
Total	**388.4**	**368.0**	**336.5**	**316.9**	**312.9**
	404.69	**404.707**	**404.705**	**404.685**	**404.688**

Table 4-9-2 Acres Harvested by Age Class by Decade (Data corresponds to Figures 8-)

Alternative NA

Age	Final Harvest Acres 1st	Acres 2nd	Acres 3rd	Acres 5th	Acres 10th
30-39	0	0	0	0	0
40-49	0	0	0	0	0
50-59	0	0	570	36476	27571
60-79	0	0	12446	13557	17421
80-99	0	0	16284	0	0
100-199	2422	47612	32788	0	0
200+	47584	12966	1195	1208	1261
Total	**50006**	**60578**	**63283**	**51241**	**46253**

Data derived from output of 1983 NPA Simex ASQ Runs.

Table 4-9-3 Volume (MMCF) Harvested by Age Class by Decade (Data corresponds to Figures 1-7)

Alternative A

Age	Final Harvest MMCF 1st	MMCF 2nd	MMCF 3rd	MMCF 5th	MMCF 10th
30-39	0.0	0.0	0.0	0.0	95.0
40-49	0.0	0.0	0.0	0.0	381.7
50-59	0.0	0.0	40.1	431.2	0.0
60-79	0.0	0.0	134.4	16.7	0.0
80-99	0.0	0.0	75.8	0.0	0.0
100-199	0.0	334.9	218.9	0.0	0.0
200+	473.2	135.7	0.0	0.0	0.0
Total	**473.2**	**470.6**	**469.2**	**447.8**	**476.7**

Table 4-9-4 Acres Harvested by Age Class by Decade (Data corresponds to Figures 8-14)

Alternative A

Age	Acres 1st	Acres 2nd	Acres 3rd	Acres 5th	Acres 10th
30-39	0	0	0	0	20384
40-49	0	0	0	0	53530
50-59	0	0	5800	55868	0
60-79	0	0	15993	2074	0
80-99	0	0	9294	0	0
100-199	0	51958	29270	0	0
200+	76583	20850	0	0	0
Total	**76583**	**72808**	**60357**	**57942**	**73914**

Data derived from TRIM-Plus ASQ harvest output files.
Results may differ slightly from other estimates generated as a result of the Ten-Year Scenario exercises.

Table 4-9-5 Volume (MMCF) Harvested by Age Class by Decade (Data corresponds to Figures 1-7)

Alternative B

Age	Final Harvest MMCF 1st	MMCF 2nd	MMCF 3rd	MMCF 5th	MMCF 10th
30-39	0.0	0.0	0.0	0.0	26.8
40-49	0.0	0.0	0.0	0.0	410.6
50-59	0.0	0.0	53.1	397.5	0.0
60-79	0.0	0.0	135.2	13.3	0.0
80-99	0.0	0.0	74.7	0.0	0.0
100-199	8.5	342.9	168.5	0.7	1.2
200+	428.5	90.9	0.8	1.0	1.6
Total	**436.9**	**433.8**	**432.3**	**412.3**	**440.2**

Table 4-9-6 Acres Harvested by Age Class by Decade (Data corresponds to Figures 8-)

Alternative B

Age	Final Harvest Acres 1st	Acres 2nd	Acres 3rd	Acres 5th	Acres 10th
30-39	0	0	0	0	5460
40-49	0	0	0	0	57280
50-59	0	0	6593	52207	0
60-79	0	0	985	1889	0
80-99	0	0	8561	0	0
100-199	1768	48774	22215	31	61
200+	65632	13330	40	46	74
Total	**67400**	**62104**	**52394**	**54173**	**62875**

Data derived from TRIM-Plus ASQ harvest output files. Results may differ slightly from other estimates generated as a result of the Ten-Year Scenario exercises.

Table 4-9-7 Volume (MMCF) Harvested by Age Class by Decade (Data corresponds to Figures 1-7)

Alternative C

	Final or Regeneration Harvest				
Age	MMCF 1st	MMCF 2nd	MMCF 3rd	MMCF 5th	MMCF 10th
30-39	0.0	0.0	0.0	0.0	0.0
40-49	0.0	0.0	0.0	0.0	0.0
50-59	0.0	0.0	0.0	0.0	0.0
60-79	0.0	0.0	4.8	12.7	0.0
80-99	0.0	0.0	0.0	0.0	0.0
100-199	54.7	53.7	51.3	7.5	90.5
200+	57.5	58.5	54.0	0.9	20.2
Total	**112.2**	**112.2**	**110.1**	**21.1**	**110.7**

Table 4-9-8 Acres Harvested by Age Class by Decade (Data corresponds to Figures 8-)

Alternative C

	Final or Regeneration Harvest				
Age	Acres 1st	Acres 2nd	Acres 3rd	Acres 5th	Acres 10th
30-39	0	0	0	0	0
40-49	0	0	0	0	0
50-59	0	0	0	0	0
60-79	0	0	810	1887	0
80-99	0	0	0	0	0
100-199	15572	13565	11382	86	8575
200+	17869	15681	12856	121	2487
Total	**33441**	**29246**	**25048**	**3494**	**11062**

Data derived from TRIM-Plus ASQ harvest output files. Results may differ slightly from other estimates generated as a result of the Ten-Year Scenario exercises.

Table 4-9-9 Volume (MMCF) Harvested by Age Class by Decade (Data corresponds to Figures 1-7)

Alternative D

	Final Harvest				
	MMCF	MMCF	MMCF	MMCF	MMCF
Age	1st	2nd	3rd	5th	10th
30-39	0.0	0.0	0.0	0.0	0.0
40-49	1.6	2.7	4.2	7.3	12.2
50-59	3.4	6.0	10.5	.9	26.1
60-79	5.0	5.1	13.3	37.2	65.4
80-99	2.6	3.5	2.9	11.6	34.8
100-199	36.4	51.9	49.0	53.7	1.6
200+	91.1	70.9	60.1	15.3	0.0
Total	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**

Table 4-9-10 Acres Harvested by Age Class by Decade (Data corresponds to Figures 8-)

Alternative D

	Final Harvest				
	Acres	Acres	Acres	Acres	Acres
Age	1st	2nd	3rd	5th	10th
30-39	0	0	0	0	0
40-49	519	930	1597	3461	3131
50-59	635	1185	2251	4059	4645
60-79	635	795	22	12006	10976
80-99	356	502	466	2328	4273
100-199	4367	6896	6854	7804	626
200+	12389	10235	9401	3029	0
Total	**18900**	**20545**	**22710**	**32687**	**23650**

Data derived from TRIM-Plus ASQ harvest output files. Results may differ slightly from other estimates generated as a result of the Ten-Year Scenario exercises. Harvest estimates set to their most constraining period. ASQ determination process differed from all other alternatives due to the 50-11-40 constraint. The TRIM-Plus model was not utilized.

Table 4-9-11 Volume (MMCF) Harvested by Age Class by Decade (Data corresponds to Figures 1-7)

Alternative E

Age	Final Harvest MMCF 1st	MMCF 2nd	MMCF 3rd	MMCF 5th	MMCF 10th
30-39	0.0	0.0	2.8	6.4	11.4
40-49	5.1	25.6	19.3	9.5	5.7
50-59	8.2	3.2	6.3	7.5	0.0
60-79	3.4	0.5	0.7	2.2	0.0
80-99	1.7	0.1	0.1	1.1	2.8
100-199	12.9	2.1	2.3	2.6	9.4
200+	0.2	0.0	0.0	0.0	1.8
Total	**31.4**	**31.5**	**31.5**	**29.2**	**31.1**

Table 4-9-12 Acres Harvested by Age Class by Decade (Data corresponds to Figures 8-)

Alternative E

Age	Final Harvest Acres 1st	Acres 2nd	Acres 3rd	Acres 5th	Acres 10th
30-39	0	48	1326	1598	2811
40-49	30	5428	4335	2134	879
50-59	1782	611	1202	1671	0
60-79	774	104	239	656	0
80-99	271	16	21	240	318
100-199	2396	339	348	370	97
200+	34	3	2	3	225
Total	**6687**	**6550**	**7474**	**6672**	**5730**

Data derived from TRIM-Plus ASQ harvest output files.
Results may differ slightly from other estimates generated as a result of the Ten-Year Scenario exercises.
Final Harvest Acreage not revised for 20% Cavity Nesters

Table 4-9-13 Volume (MMCF) Harvested by Age Class by Decade (Data corresponds to Figures 1-7)

Alternative P

Age	Final or Regeneration Harvest MMCF 1st	MMCF 2nd	MMCF 3rd	MMCF 5th	MMCF 10th
30-39	0.0	0.0	0.0	0.0	0.0
40-49	0.0	0.0	0.0	0.0	0.0
50-59	0.0	0.0	0.0	0.0	0.0
60-79	5.4	9.1	7.8	65.4	0.3
80-99	13.7	9.2	7.6	15.0	58.4
100-199	68.0	59.2	68.9	8.1	56.1
200+	72.7	70.2	48.4	4.0	30.9
Total	**159.8**	**7.6**	**132.7**	**92.4**	**5.7**

Table 4-9- Acres Harvested by Age Class by Decade (Data corresponds to Figures 8-)

Alternative P

Age	Final or Regeneration Harvest Acres 1st	Acres 2nd	Acres 3rd	Acres 5th	Acres 10th
30-39	0	0	0	0	0
40-49	0	0	0	0	0
50-59	0	0	0	0	2918
60-79	2035	1752	1069	8637	32
80-99	2241	1595	1269	08	4405
100-199	206	10519	10431	1775	4232
200+	933	078	9363	1357	6377
Total	**33415**	**27944**	**22132**	**13177**	**17964**

Data derived from TRIM-Plus ASQ harvest output files.
Results may differ slightly from other estimates generated as a result of the Ten-Year Scenario exercises.

Figure 4-9-1. Final Harvest Volume by Age Class and Decade
Alternative NA - ASQ 405 MCF/Decade

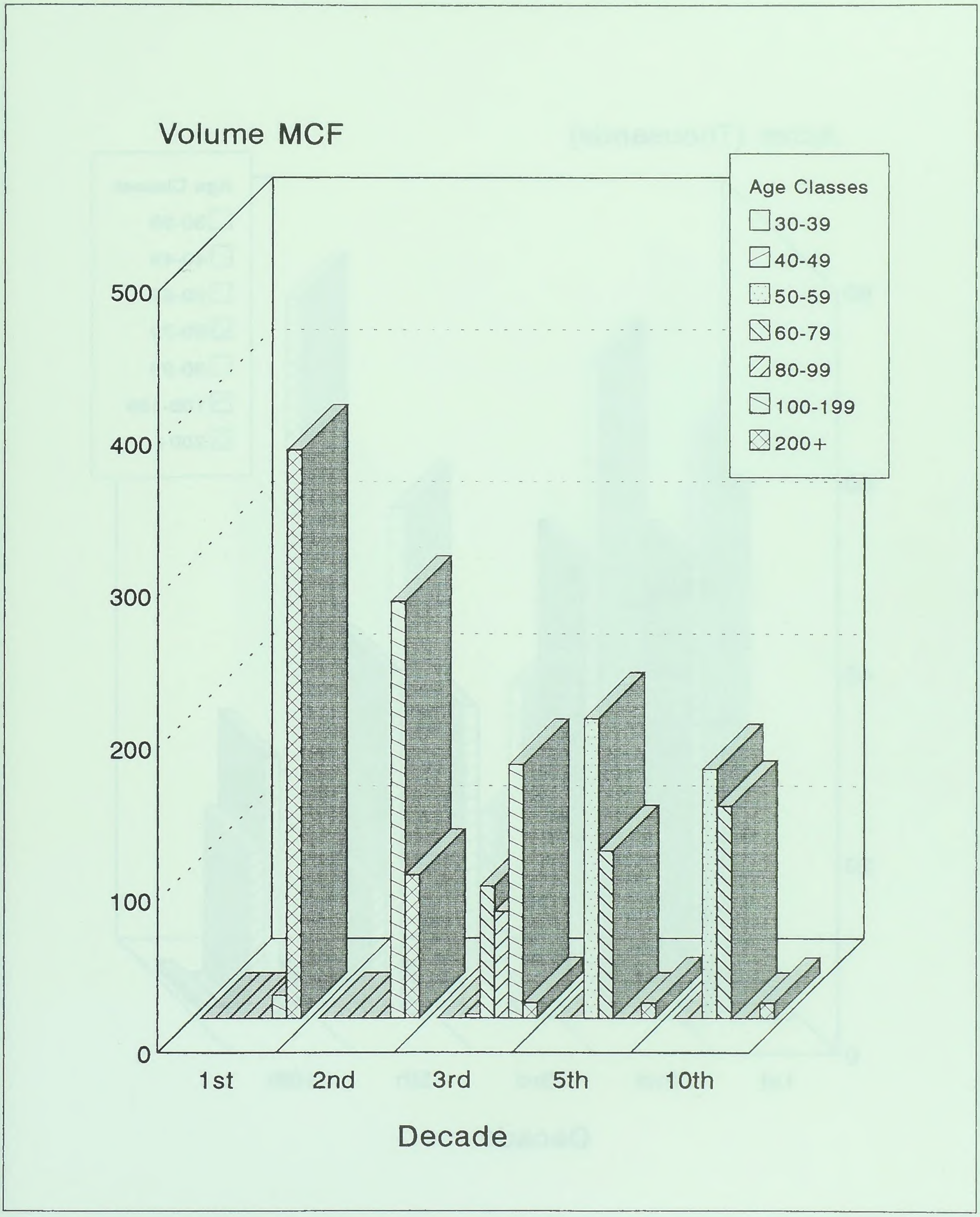


Figure 4-9-2. Final Harvest Acreage by Age Class and Decade

Alternative NA - ASQ 405 MCF/Decade

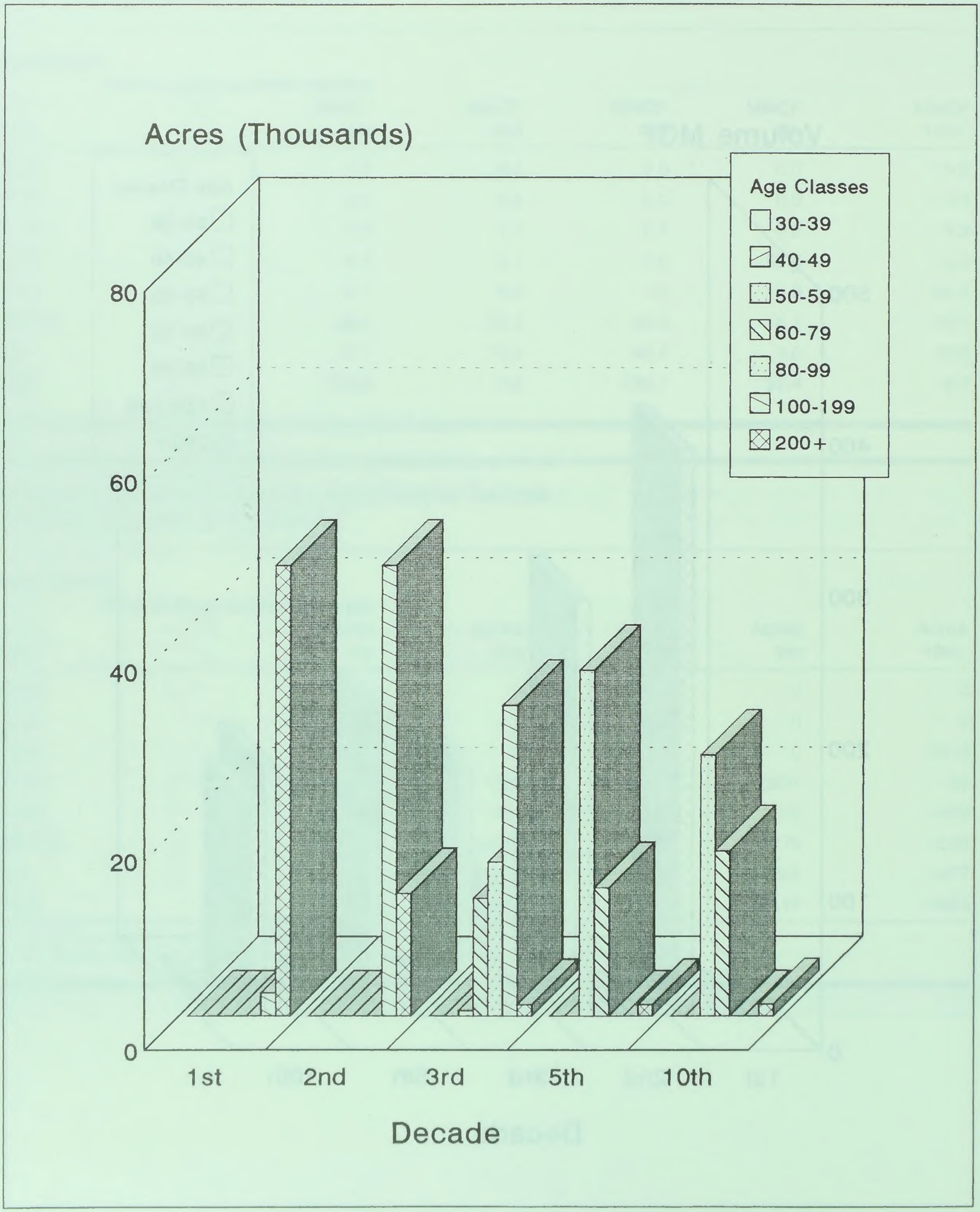


Figure 4-9-3. Final Harvest Volume by Age Class and Decade

Alternative A - ASQ 477 MCF/Decade

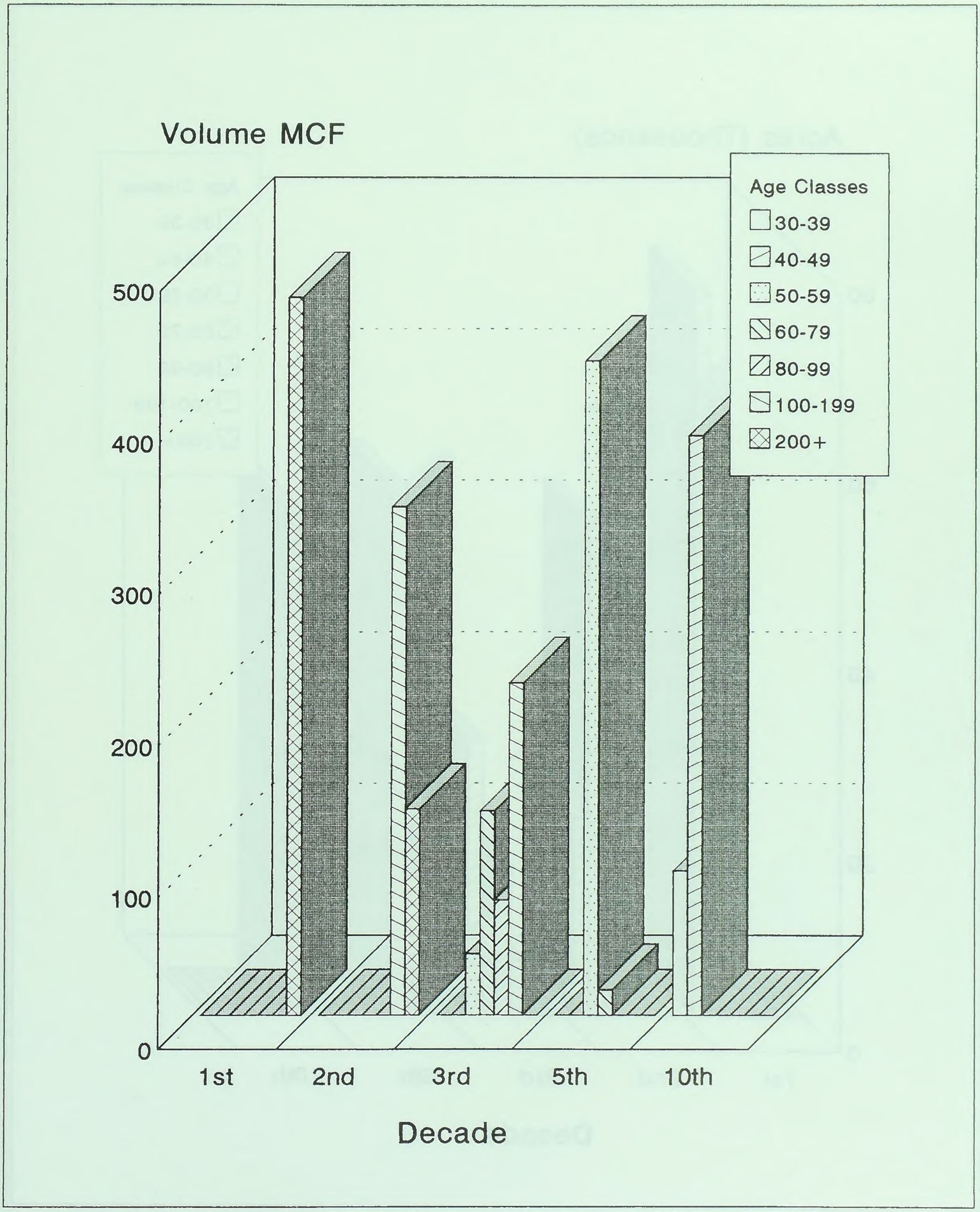


Figure 4-9-4. Final Harvest Acreage by Age Class and Decade

Alternative A - ASQ 477 MCF/Decade

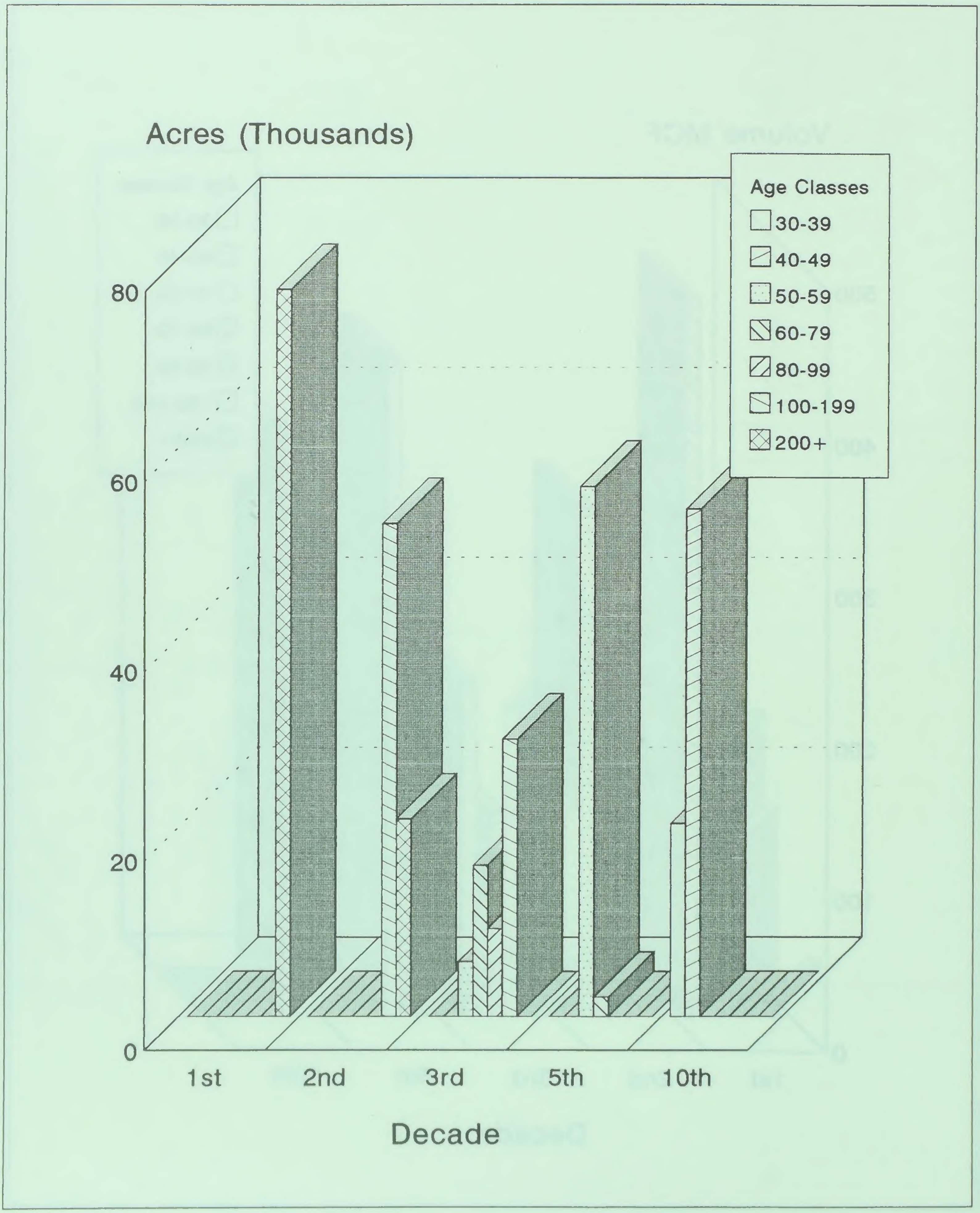


Figure 4-9-5. Final Harvest Volume by Age Class and Decade

Alternative B - ASQ 440 MCF/Decade

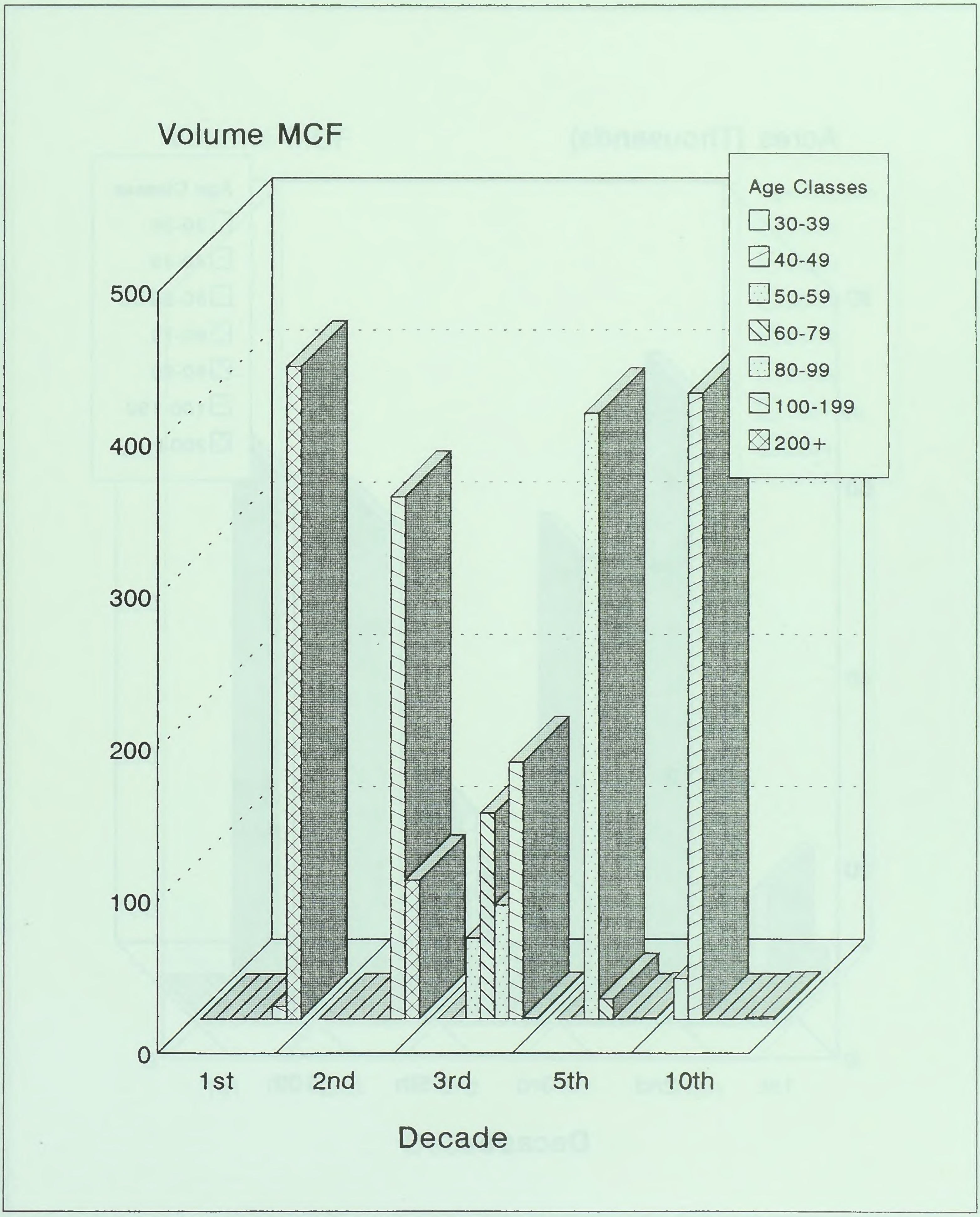


Figure 4-9-6. Final Harvest Acreage by Age Class and Decade

Alternative B - ASQ 440 MCF/Decade

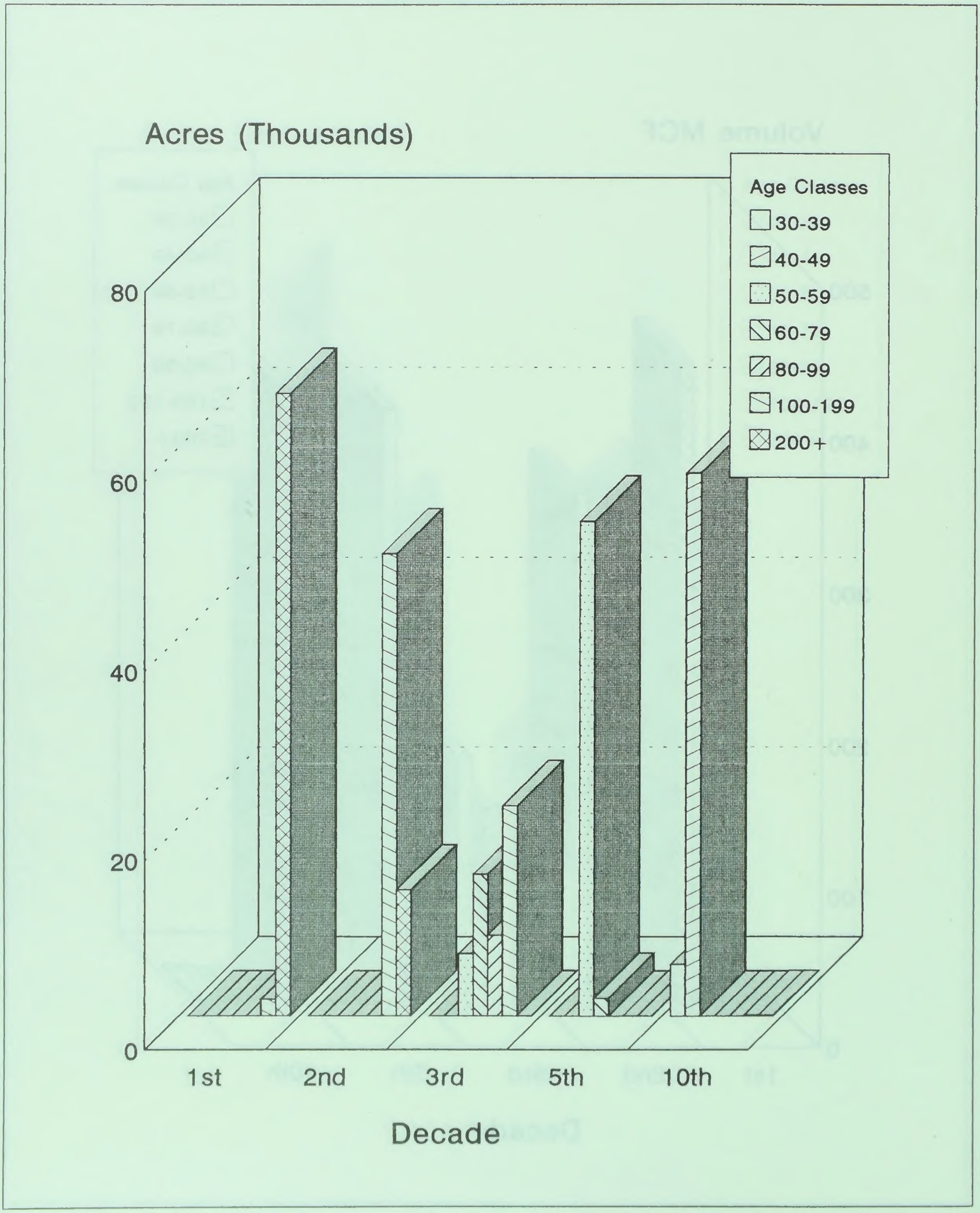


Figure 4-9-7. Final Harvest Volume by Age Class and Decade
Alternative C - ASQ 112 MCF/Decade

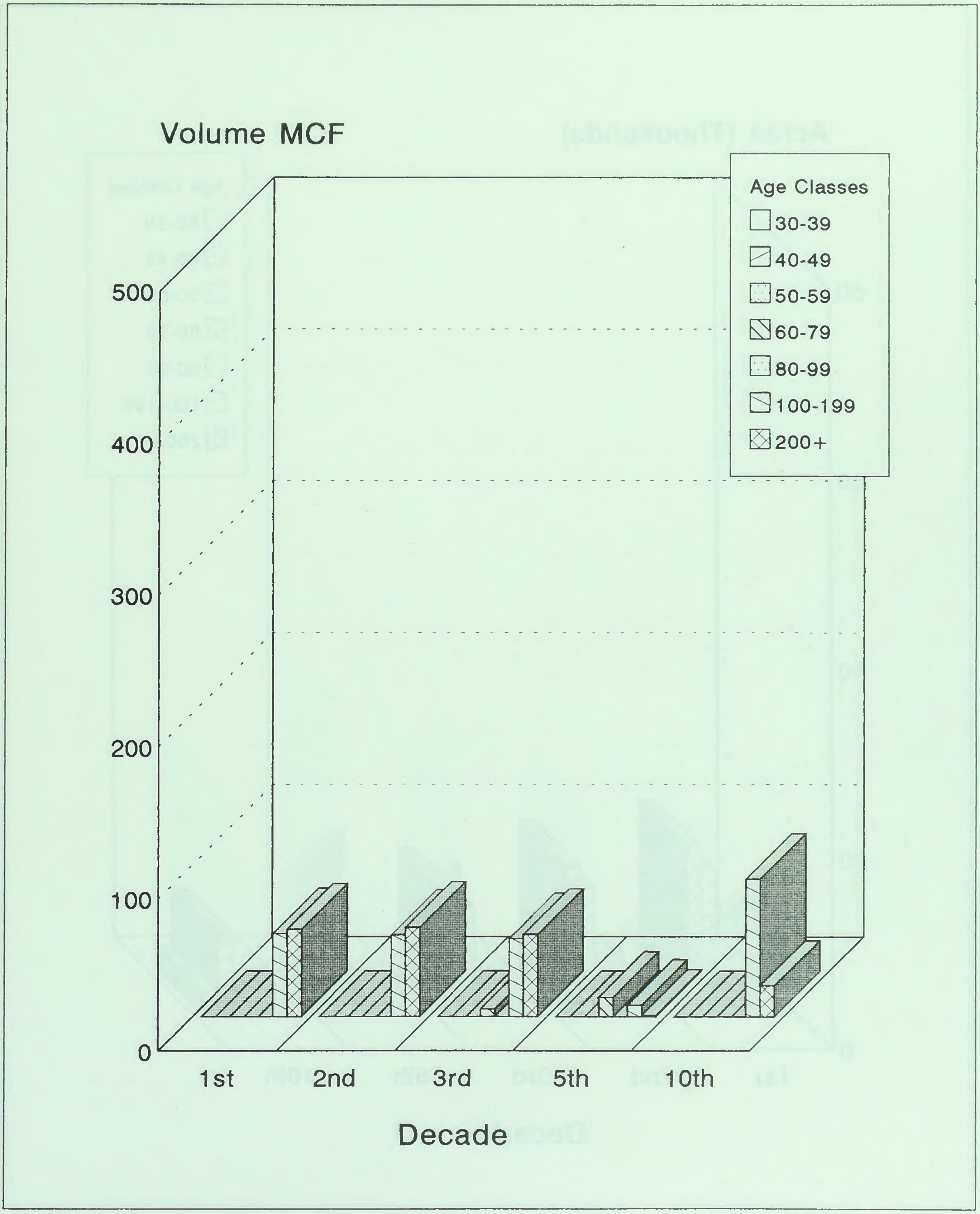


Figure 4-9-8. Final Harvest Acreage by Age Class and Decade

Alternative C - ASQ 112 MCF/Decade

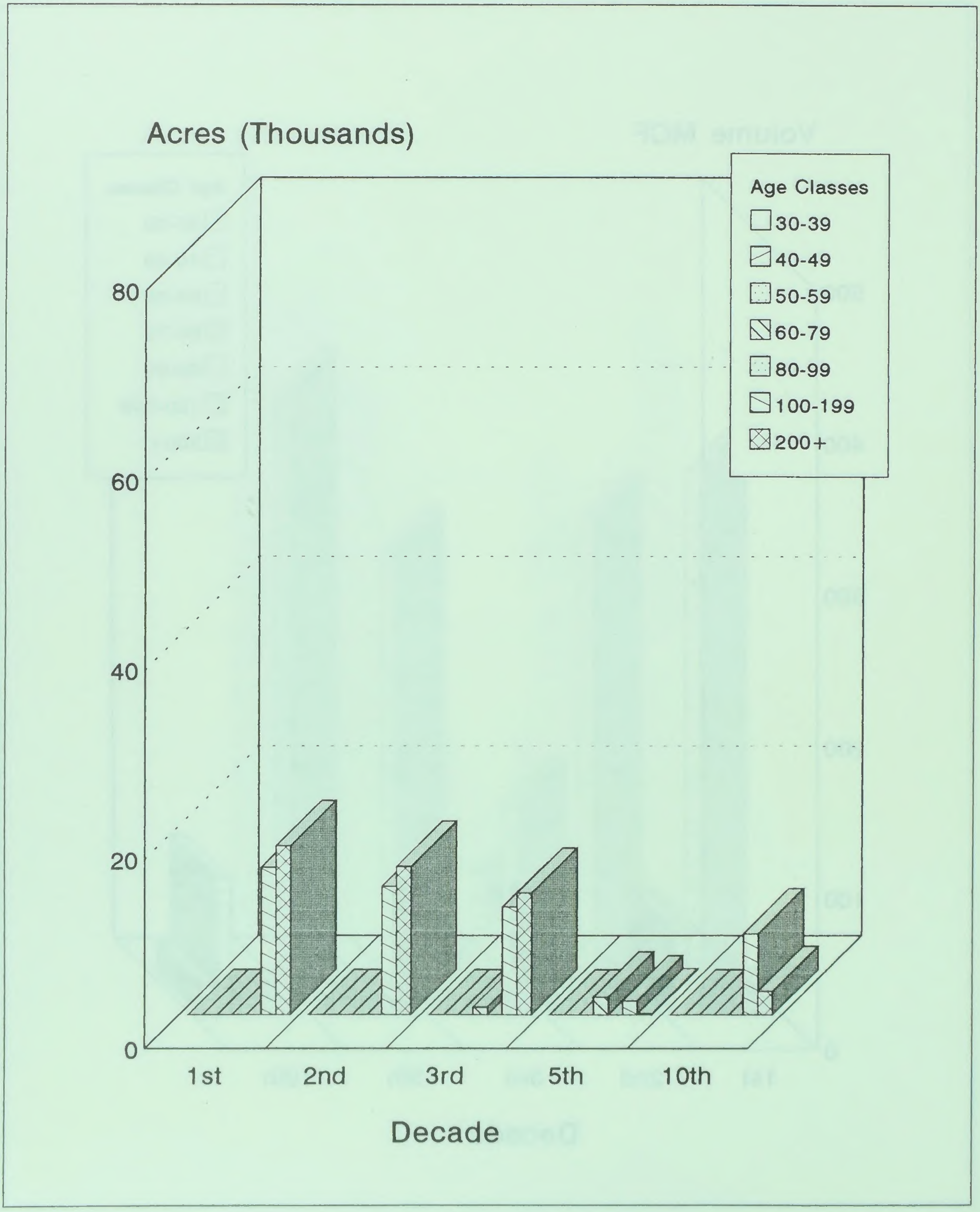


Figure 4-9-9. Final Harvest Volume by Age Class and Decade
Alternative D - ASQ 143 MCF/Decade

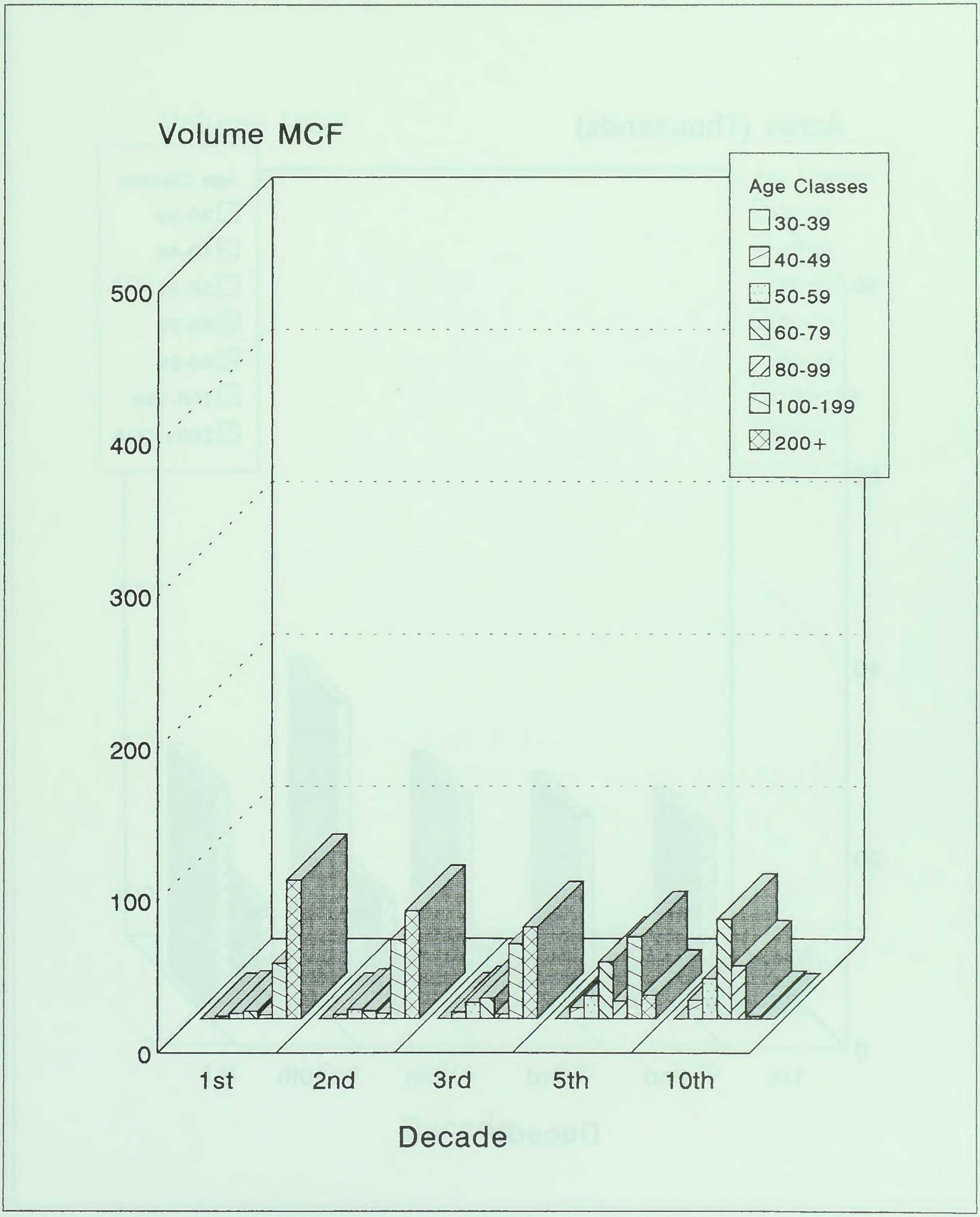


Figure 4-9-10. Final Harvest Acreage by Age Class and Decade
Alternative D - ASQ 143 MCF/Decade

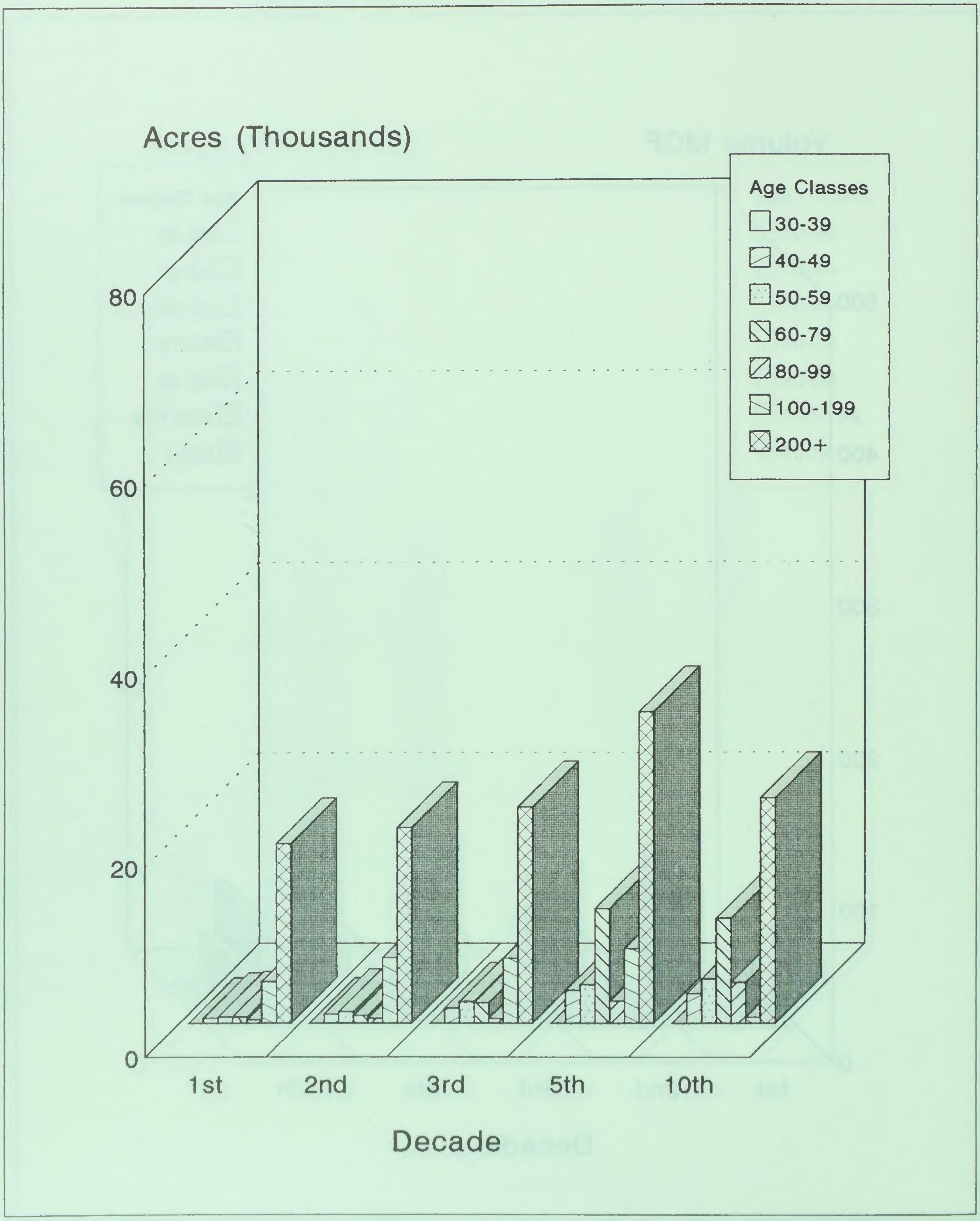


Figure 4-9-11. Final Harvest Volume by Age Class and Decade
Alternative E - ASQ 32 MCF/Decade

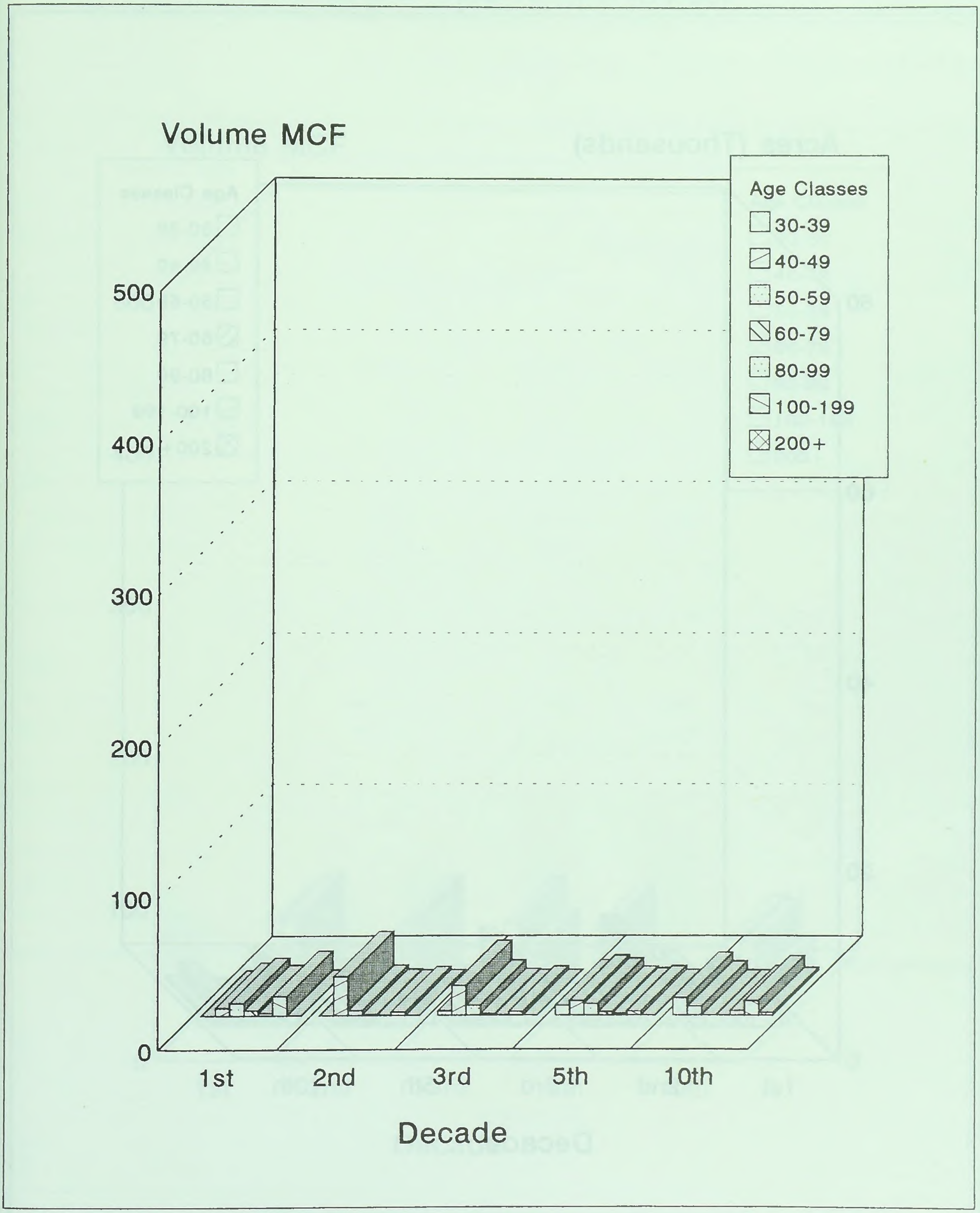


Figure 4-9-12. Final Harvest Acreage by Age Class and Decade

Alternative E - ASQ 32 MCF/Decade

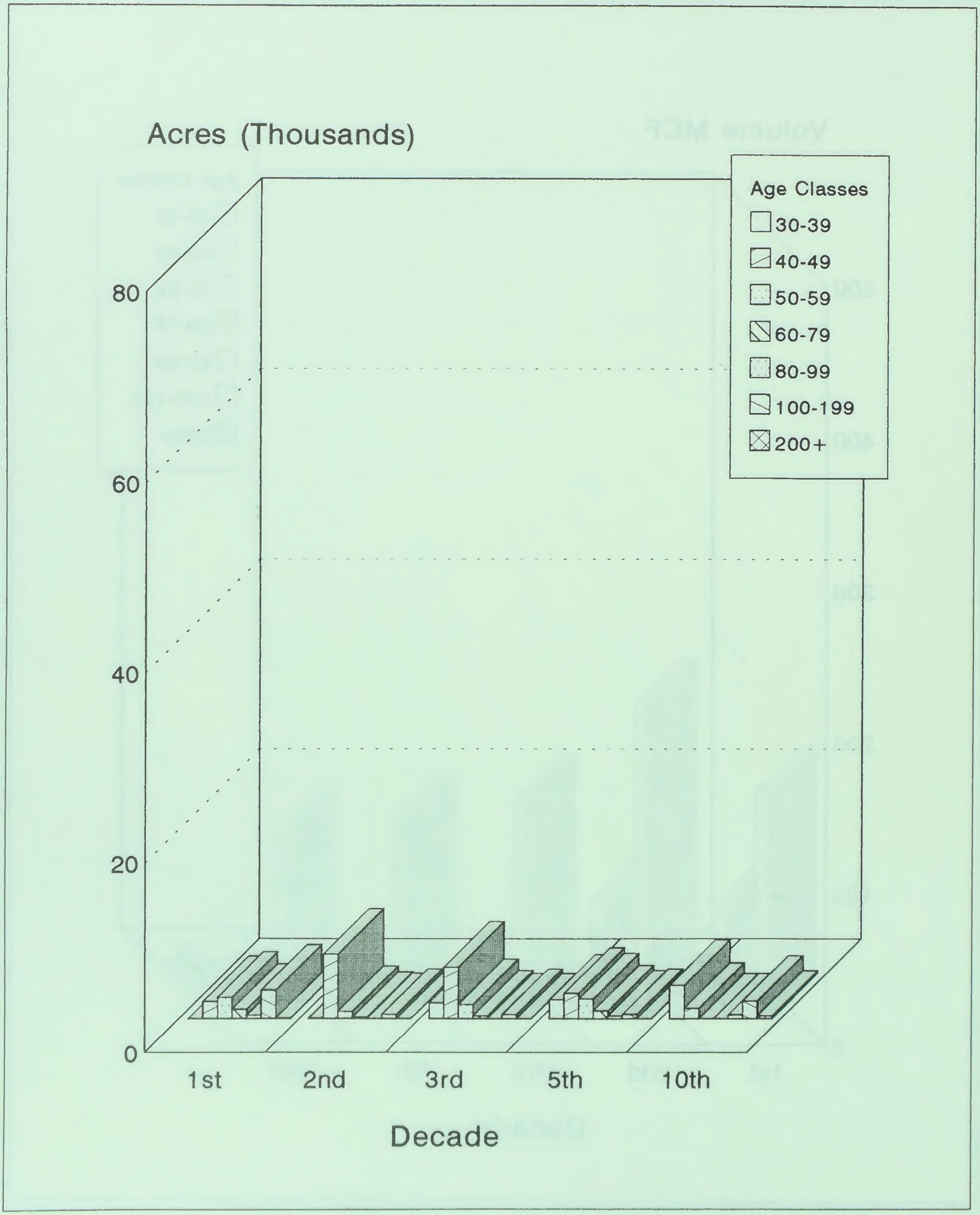


Figure 4-9-13. Final Harvest Volume by Age Class and Decade

Alternative P - ASQ 105 MCF/Decade

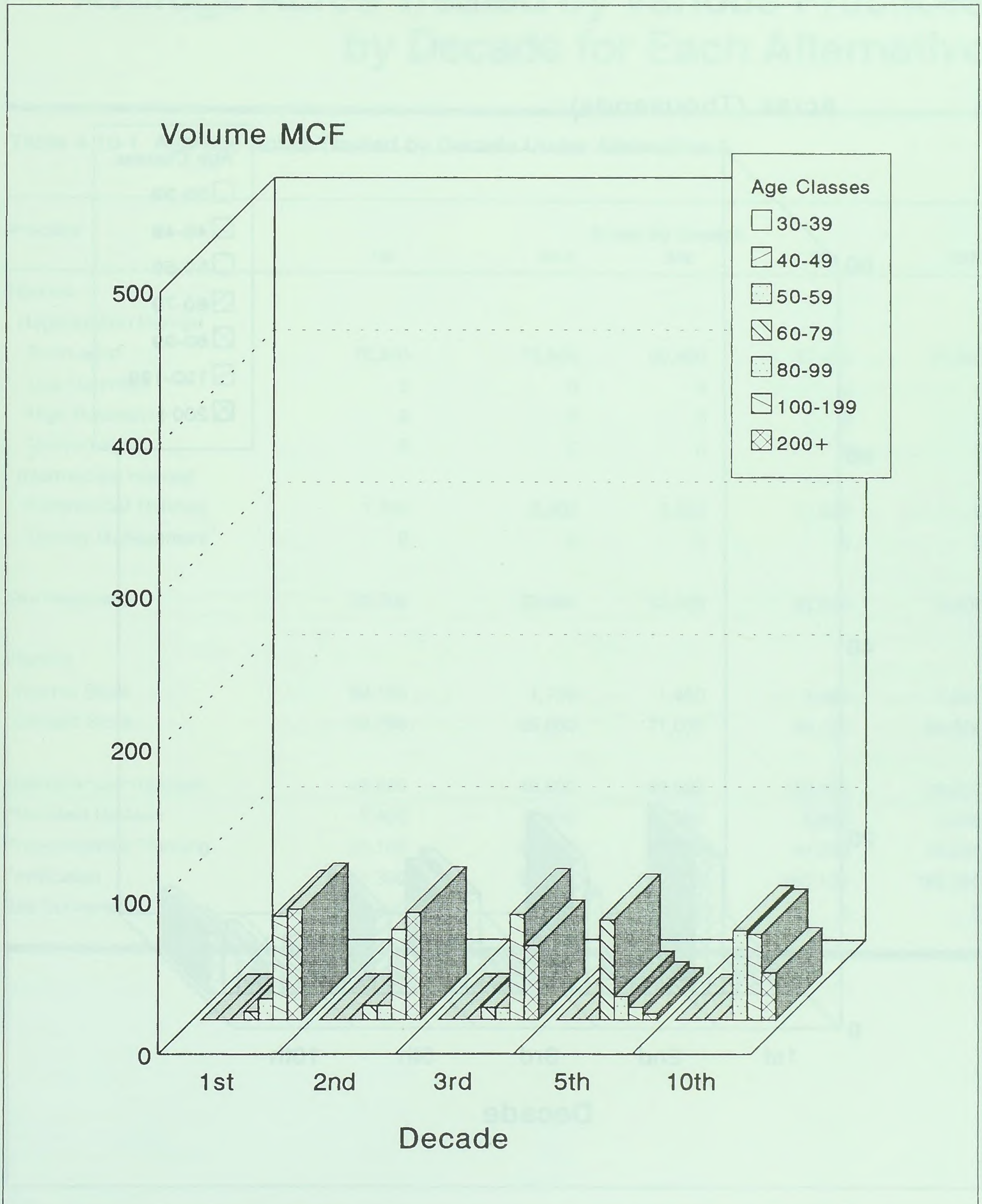
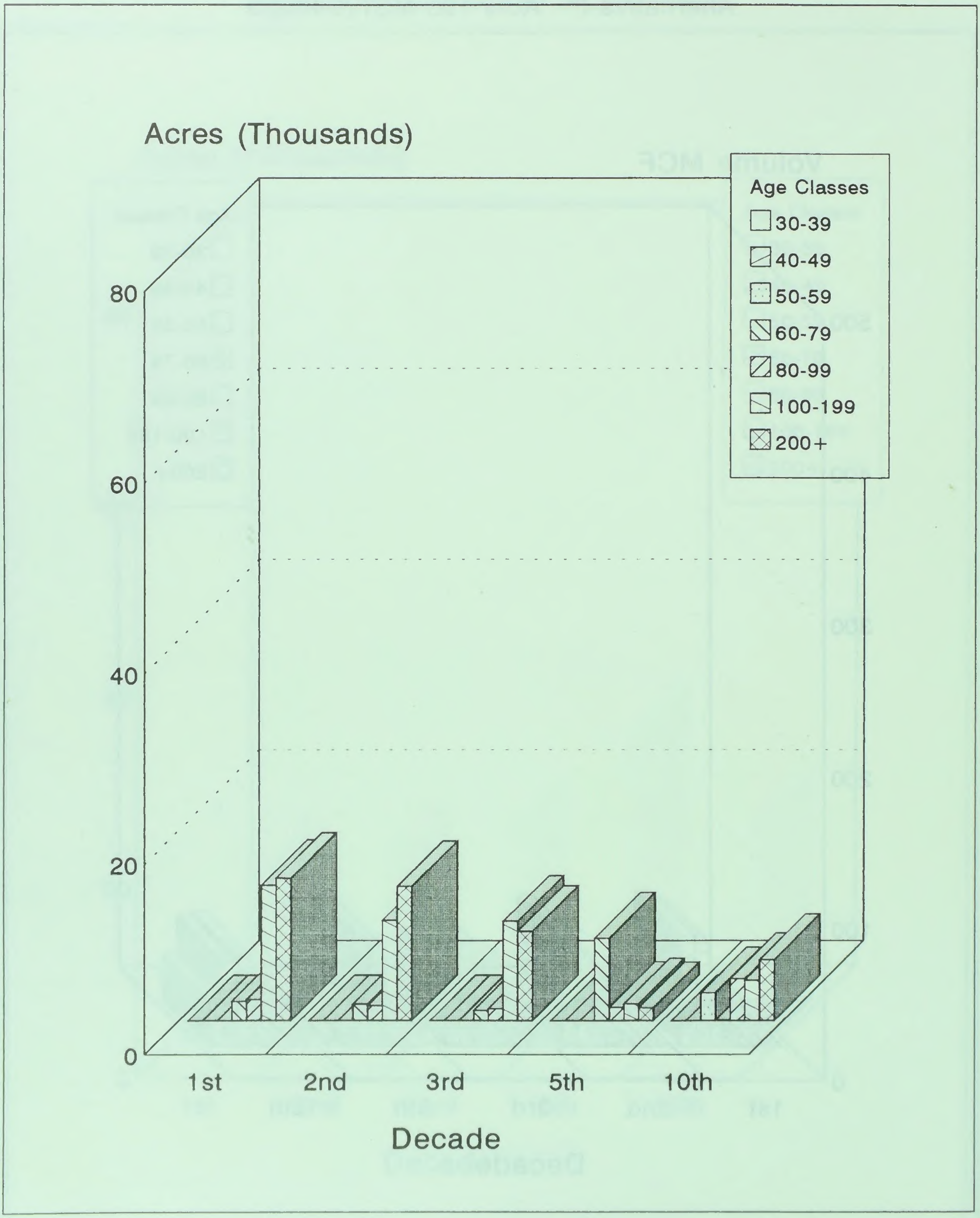


Figure 4-9-14. Final Harvest Acreage by Age Class and Decade
Alternative P - ASQ 163 MCF/Decade



Appendix 4-10
Average Acres Treated by Various Practices by Decade for Each Alternative

Table 4-10-1 Average Acres Treated by Decade Under Alternative A

Practice	Acres By Decade				
	1st	2nd	3rd	5th	10th
Harvest					
Regeneration Harvest					
Even-aged	76,600	72,800	60,400	57,900	73,900
Low Retention	0	0	0	0	0
High Retention	0	0	0	0	0
Uneven-aged	0	0	0	0	0
Intermediate Harvest					
Commercial Thinning	1,700	2,900	3,600	11,200	0
Density Management	0	0	0	0	0
Site Preparation	33,700	33,600	33,000	32,900	3,400
Planting					
Normal Stock	54,100	1,700	1,400	1,400	1,800
Genetic Stock	34,700	85,600	71,000	68,100	86,900
Maintenance/Protection	49,600	48,800	40,500	38,800	49,500
Plantation Release	7,400	7,300	6,000	5,800	7,400
Precommercial Thinning	53,100	57,400	54,600	44,200	44,200
Fertilization	62,300	51,700	134,800	195,100	182,500
Site Conversion	600	0	0	0	0

Table 4-10-2 Average Acres by Decade Under Alternative B

Practice	Acres By Decade 1st	2nd	3rd	5th	10th
Harvest					
Regeneration Harvest					
Even-aged	67,400	62,100	52,400	54,200	62,900
Low Retention	0	0	0	0	0
High Retention	0	0	0	0	0
Uneven-aged	0	0	0	0	0
Intermediate Harvest					
Commercial Thinning	1,600	3,100	3,800	11,000	0
Density Management	0	0	0	0	0
Site Preparation	33,300	33,100	32,600	32,700	33,100
Planting					
Normal Stock	45,200	1,500	1,300	1,300	1,500
Genetic Stock	34,700	73,000	61,600	63,700	74,000
Maintenance/Protection	44,600	41,600	35,100	36,300	42,100
Plantation Release	6,700	6,200	5,200	5,400	6,300
Precommercial Thinning	48,200	46,400	42,700	36,500	42,100
Fertilization	56,700	47,400	115,300	163,400	152,400
Site Conversion	500	0	0	0	0

Table 4-10-3 Average Acres Treated by Decade Under Alternative C

Practice	Acres By Decade				
	1st	2nd	3rd	5th	10th
Harvest					
Regeneration Harvest					
Even-aged	0	0	0	0	0
Low Retention	13,400	11,800	10,000	1,400	4,500
High Retention	20,000	17,500	15,100	2,100	6,600
Uneven-aged	0	0	0	0	0
Intermediate Harvest					
Commercial Thinning	0	0	0	0	0
Density Management	0	0	1,100	40,200	1,200
Site Preparation	25,900	23,300	20,800	2,800	8,800
Planting					
Normal Stock	19,400	17,600	15,700	2,200	6,600
Genetic Stock	19,400	17,600	15,700	2,200	6,600
Maintenance/Protection	21,700	19,600	17,500	2,400	7,400
Plantation Release	3,200	2,900	2,600	400	1,100
Precommercial Thinning	40,200	23,500	20,600	7,600	6,700
Fertilization	47,300	40,400	45,500	45,500	0
Site Conversion	400	0	0	0	0

Table 4-10-4 Average Acres Treated by Decade Under Alternative D

Practice	Acres By Decade				
	1st	2nd	3rd	5th	10th
Harvest					
Regeneration Harvest					
Even-aged	18,900	20,500	22,700	32,700	30,000
Low Retention	0	0	0	0	0
High Retention	0	0	0	0	0
Uneven-aged	0	0	0	0	0
Intermediate Harvest					
Commercial Thinning	1,000*	1,000*	1,000*	1,000*	1,000*
Density Management	0	0	0	0	0
Site Preparation	15,100	16,400	18,100	26,000	24,000
Planting					
Normal Stock	9,300	500	500	800	700
Genetic Stock	13,300	24,000	27,000	38,500	35,300
Maintenance/Protection	12,700	13,700	15,200	21,900	20,100
Plantation Release	1,900	2,000	2,300	3,300	3,000
Precommercial Thinning	30,900	8,800	9,600	12,900	13,800
Fertilization	36,300	32,200	48,000	62,200	53,900
Site Conversion	300	0	0	0	0

*Minimum available estimate

Table 4-10-5 Average Acres Treated by Decade Under Alternative E

Practice	Acres By Decade 1st	2nd	3rd	5th	10th
Harvest					
Regeneration Harvest					
Even-aged	6,700	6,600	7,500	6,700	5,700
Low Retention	0	0	0	0	0
High Retention	0	0	0	0	0
Uneven-aged	0	0	0	0	0
Intermediate Harvest					
Commercial Thinning	100	0	0	1100	300
Density Management	0	0	0	0	0
Site Preparation	5,400	5,300	5,900	5,400	4,600
Planting					
Normal Stock	1,600	200	200	200	100
Genetic Stock	6,400	7,800	8,800	7,900	6,700
Maintenance/Protection	4,500	4,400	5,000	4,500	3,800
Plantation Release	700	700	800	700	600
Precommercial Thinning	7,100	1,100	1,100	1,200	1,000
Fertilization	8,288	11,400	14,300	15,900	4,500
Site Conversion	100	0	0	0	0

Table 4-10-6 Average Acres Treated by Decade Under Alternative PA

Practice	Acres By Decade 1st	2nd	3rd	5th	10th
Harvest					
Regeneration Harvest					
Even-aged	22,674	19,035	14,778	7,832	8,451
Low Retention	10,741	8,909	7,354	5,345	222
High Retention	0	0	0	0	6,373
Partial Retention	0	0	0	0	0
Uneven-aged	0	0	0	0	0
Intermediate Harvest					
Commercial Thinning	1,300	2,600	10,600	5,500	4,900
Density Management	100*	15,800	0	19,500	1,500
Site Preparation	25,800	22,400	17,700	10,500	12,000
Planting					
Normal Stock	9,700	700	500	300	400
Genetic Stock	29,000	33,000	26,000	15,500	18,000
Maintenance/Protection	21,600	18,800	14,800	8,800	10,100
Plantation Release	3,200	2,800	2,200	1,300	1,500
Precommercial Thinning	49,600	27,200	22,700	14,500	11,800
Fertilization	58,200	48,600	76,000	89,900	29,000
Site Conversion	500	0	0	0	0

*Final Preferred Alternative first decade estimate expected to be about 5,100 acres. Additional field survey and analysis pending.

Appendix 4-11
Summary Effect of Land Use Allocations on Lands Available for Timber Production

Percent of Forest Acres Available for Timber Production

Alternative	Suitable Woorlands	Suitable Commercial Forestland			Special Management[1] Areas		Total Acreage
	Acreage	Intensive Acreage	Restricted Acreage	Percent	Acreage	Percent	
NA	n/a	331,600	35,900	91.4	34,400	8.6	401,900
A	2,900	353,300	0	89.3	39,400	10.0	395,600
B	2,600	318,900	2,400	81.2	71,600	18.1	395,500
C	100	0	270,200	68.3	125,300	31.7	395,600
B	0	159.300	47.900	52.4	188,400	47.6	395,600
E	0	23,800	23,400	12.0	348,200	88.0	395,500
PA	0	144,300	188,300	84.1	63,000	15.9	395,600

[1]Areas not managed for timber production.

Appendix 4-12
Methodology for Assessing Effects on Biological Diversity

Introduction

Biological diversity will be defined, for purposes of BLM planning in western Oregon, as: The variety of life and its process (Keystone Dialogue Report 1991).

Assessment Methods

Biological diversity will be addressed using three methods which utilize our existing data base to provide relevant information for comparison of the plan alternatives.

Method 1: Fragmentation Analysis

Assumptions:

1. An indicator of biological diversity (or lack of it) on BLM-administered lands in western Oregon is fragmentation of mature and older natural forest stands. This would be so because of the checkerboard ownership pattern of these lands, the rather long history of logging on them, and the even greater incidence of past logging on most intermingled private lands, which combine to result in a high degree of fragmentation.

2. The size of older forest patches combined with the seral stage of adjacent stands has been shown to affect older forest stand characteristics so that effective older forest habitat is substantially less than actual older forest acres would indicate. Estimates of the distance from adjacent clear cuts where effective (interior) habitat begins range from 400 to 800 feet. In light of the fragmentation of BLM's older forest stands, the 400-foot distance seems a more appropriate measure to use in defining how much effective older forest habitat BLM may have. Adjacent stands at least half the height of the older forest stand are assumed to be large enough to mitigate this edge effect. On most BLM-administered lands in western Oregon, this half height is attained at about age 50. To represent this mitigating effect conservatively, age classes younger than 70 will be assumed to be responsible for such effects.

3. Partial retention management prescriptions providing for 35 percent basal area or greater retention at regeneration harvest of stands possessing old-growth characteristics will retain such characteristics after regeneration harvest.

4. Open roads also affect interior habitat, but efficient quantitative analysis of the effects of such roads on size of blocks of effective old-growth requires more refined GIS software than is currently available to BLM.

5. Slope and aspect may also affect the relevant distance for calculating interior habitat, but neither existing research nor current analytical capability encourage an attempt to include such factors in an RMP/EIS analysis.

6. Block isolation may also be a factor. See Assessment Method 2.

7. Although defining all stands of age class 200+, and only such stands, as old-growth substantially oversimplifies, that is the only consistent and reliable surrogate for old-growth condition currently available for BLM to use in GIS- based analyses.

Analytical Techniques:

1. For each alternative, identify the number of blocks of old-growth (age class 200+) forest stands, and of mature and old-growth (combined) stands. expected to occur on BLM-administered lands, and the total acreage of such blocks. Stratify the blocks by size class: 0-79 acres, 80-299, 300-999 and 1000. Analyze for the short term (10 years after plan implementation) and the long-term (100 years). The short-term analysis will utilize the 10 year representative timber management scenario.

2. For each alternative, identify the number of blocks of old-growth forest interior habitat expected to occur on BLM-administered lands and the total acreage of such stands. Stratify the blocks by size class as in technique "1". Analyze for the short term and the long term.

3. Where relevant, substratify the above by major plant grouping.

4. Discuss the existence, retention and/or long-term development of any blocks substantially larger than 1,000 acres.

5. Discuss generally the occurrence and density in these blocks of roads that would not be closed, by alternative; relate to quality of blocks.

6. Discuss the spatial arrangement of the blocks expected to remain; for example, whether they would be well dispersed or would cluster in portions of the planning area, and how well they provide connectivity between major reserves (e.g., wilderness areas). Also discuss their stratification by elevation zone (tree breeding zone). Subaggregation of the data by resource area, elevation zone or other relevant geographic unit to facilitate this analysis, is optional.

7. Also discuss the potential for catastrophic events (e.g., fire, windstorm) affecting the quantified conclusions.

Method 2: Spatial Fragmentation Analyses

Assumptions:

1. The distance between old-growth stands, if large, can lead to isolation of some species of animals and plants that depend on these habitats. The resulting inbreeding can reduce the ability of these species to survive.

2. The average distance between old-growth blocks of a certain size can be treated as an index of spatial fragmentation and used for comparison of alternatives.

3. Given the current fragmentation and geographical pattern of BLM-administered lands, the average distances between blocks of 80-plus and of 600-plus acres are most meaningful to calculate.

Analytical Techniques:

1. For each alternative, calculate as in index of spatial fragmentation, the average distance between blocks of old-growth (200+) in the short term and long term (100 years). For simplicity, treat areas allocated to partial retention of 35 percent or more basal area as old-growth in this analysis only if the residual stand will have attained 200 years

2. Conduct a similar analysis considering only blocks in biological corridors identified during design of alternative C.

Method 3: Seral Stage Analysis

Assumptions:

1. Closed canopy forest stands (primarily mid and late seral stages) are much less diverse than stands in either the early seral stage (which lasts until canopy closure) or the older age classes that occur after the forest canopy begins to open again. Bruce, et al, 1985 (in Brown, ed.) and Schoemaker and McKee, 1988.

Analytical Techniques:

1. Calculate estimated conifer forest composition (percent of each seral stage) for each alternative in the short term (10 years) and long term (100 years), and compare to the existing situation. Subdivide the mature seral stage data into closed canopy and open canopy condition, based on the age class where the canopy most typically reopens. Specifically consider also the density management prescriptions of alternative C. As appropriate, disaggregate and/or discuss by major plant group. Also disaggregate by analytical watershed.

2. Discuss how well the alternatives would retain or improve biological diversity by providing open canopy conditions. Address cumulative effects with other ownerships.

3. Discuss the potential for catastrophic events affecting the quantified conclusions. Relate to the recent history of wildfires and other catastrophic events.

Display Techniques:

Display existing, short-term and long-term habitat composition on BLM-administered lands for each alternative using bar graphs.

Method 4: Dead and Down Woody Material Analysis.

See Appendix 4-6.

Method 5: Supplemental Analysis and Summary Display.

Analytical Techniques:

In narrative, with quantification where relevant, discuss the effects of the alternatives on the following. Cross reference related discussions in other EIS sections, as appropriate.

- species diversity including specific focus on special status species, tree species mix, and competing vegetation (which may be suppressed by management actions).
- variety of ecosystems (e.g., talus slopes, meadows, water bodies, hardwoods, riparian zones, RNAs).
- special niches (e.g., snags, down logs).
- genetic diversity of tree species favored for timber management.

Appendix 4-13
Average Percent Species Composition; Current and by Prescription at End of Rotation

Table 4-13-1 Average Percent Species Composition Current Condition

Age Class	Douglas Fir	Pines	Grand Fir	Other Conifer	Hardwoods
5-10	83	3	2	4	8
20	70	4	4	6	16
30	70	2	2	9	17
40-90	69	2	2	9	17
100-190	75	3	2	12	9
200+	66	2	4	22	7

Age classes 5-20 are shown on a trees per acre basis. Other age classes are shown on a basal area per acre basis.
Actual species composition is highly variable between stands. Percentages shown are averages calculated from Continuous Forest Inventory (CFI) plots.

Table 4-13-2 Average Percent Species Composition by Prescription at end of Rotation

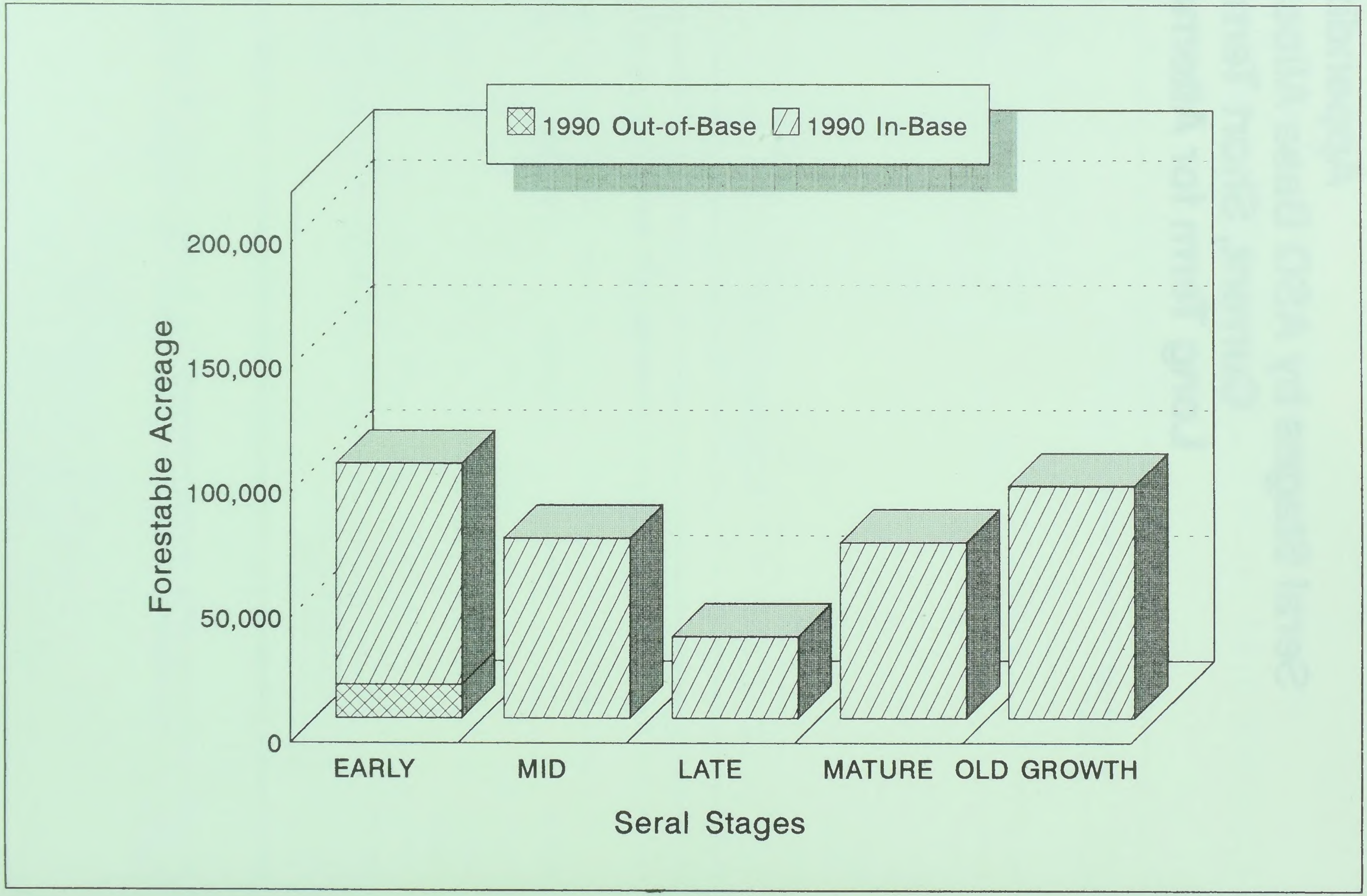
Species	Even-Aged	CLR/CONN	CHR/OGEA	Current OG
Douglas-Fir	89	78	79	66
Pines	5	4	2	2
Grand Fir	4	2	2	4
Other CON.	2	12	16	22
Hardwoods	0	4	1	7

Even-Aged = Alt. A, B, D, E, and GFMA of Alt. P.
CLR/CONN = Alt. C low retention and Alt. P connectivity.
CHR/OGEA = Alt. C high retention and Alt. P OGEA.
Current OG = Current average of district old-growth >200 yrs.

Averages shown were derived from Organon model outputs. They represent district average species composition for a given silvicultural prescription at rotation age. Individual stand composition will vary average depending on site characteristics.

Appendix 4-14
Seral Stages by ASQ Base Allocation; Current, Short Term, and Long Term for Alternatives

Figure 4-14-1. 1990 Seral Stages by ASQ Base Allocation
Alternative A



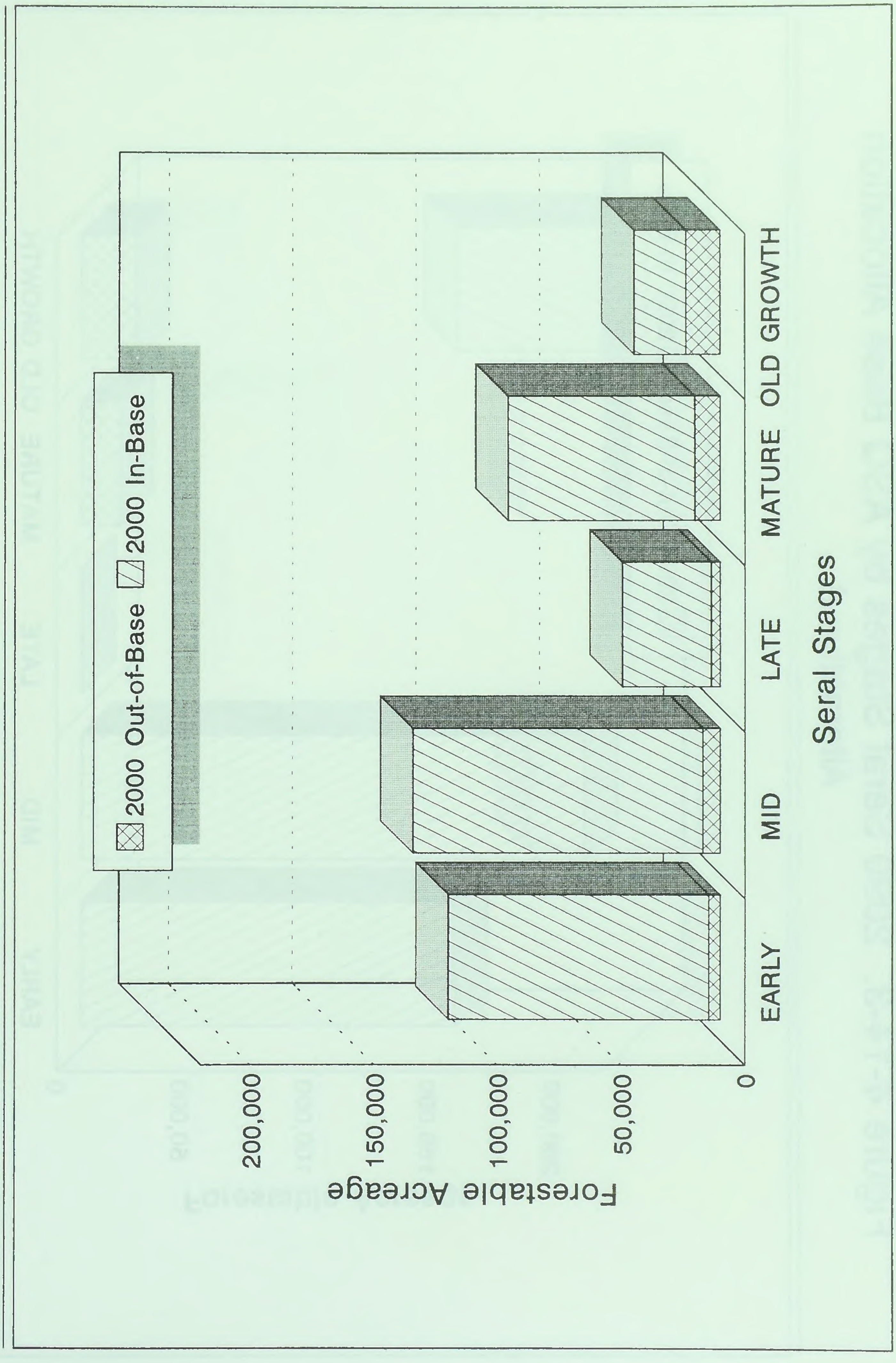


Figure 4-14-2. 2000 Seral Stages by ASQ Base Allocation
Alternative A

Figure 4-14-3. 2090 Seral Stages by ASQ Base Allocation
Alternative A

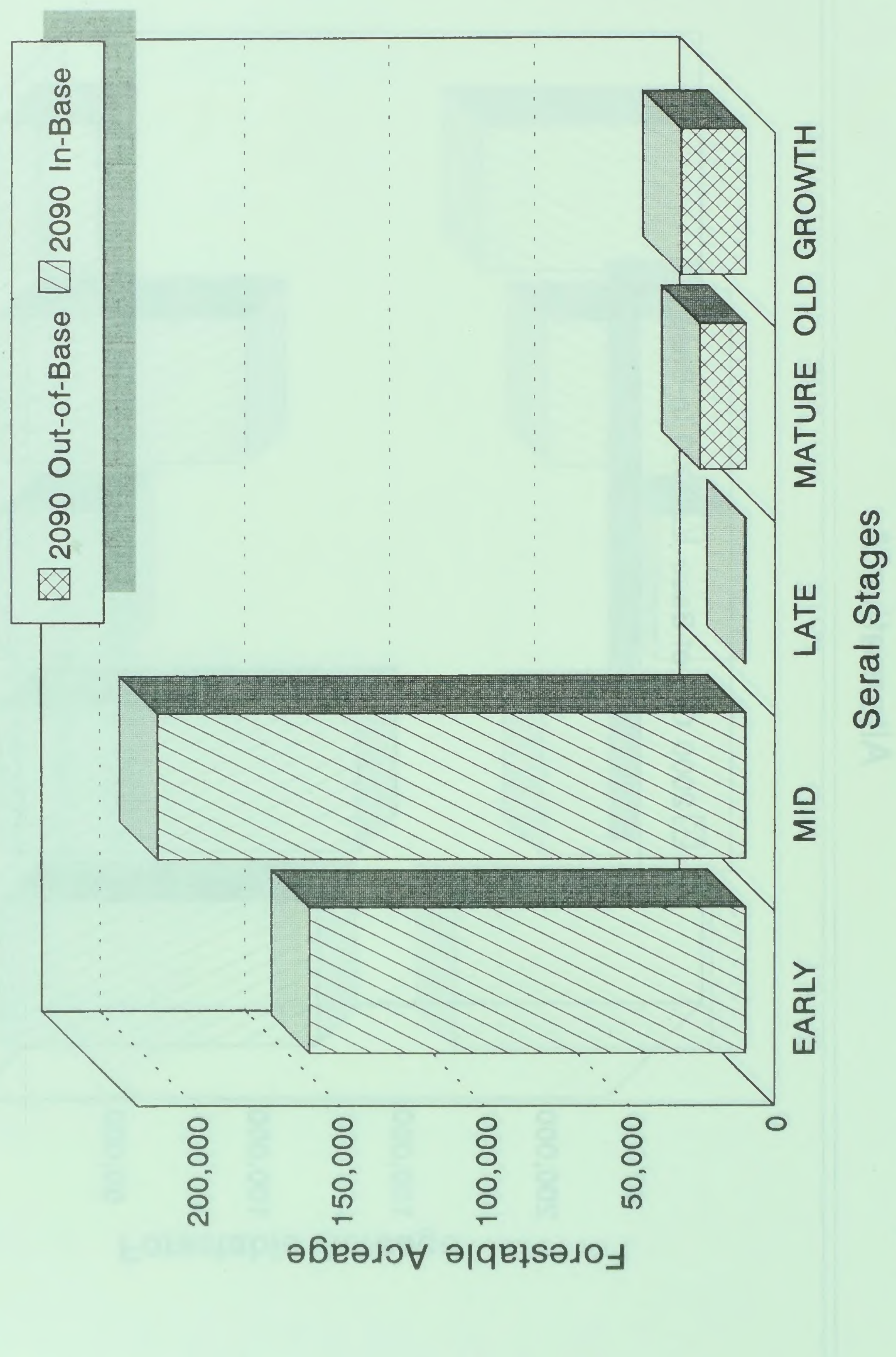


Figure 4-14-4. 1990 Seral Stages by ASQ Base Allocation
Alternative B

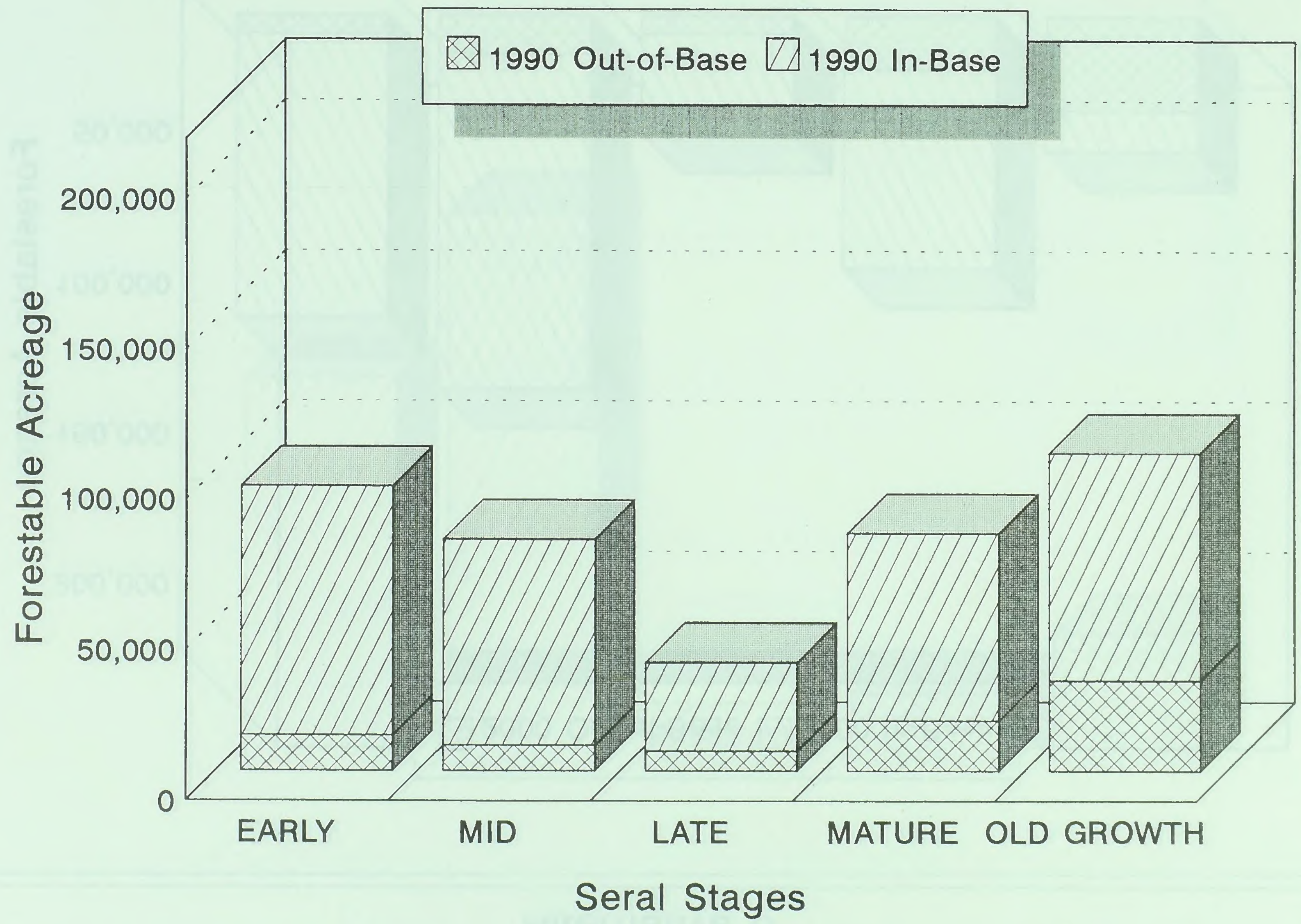


Figure 4-14-5. 2000 Seral Stages by ASQ Base Allocation
Alternative B

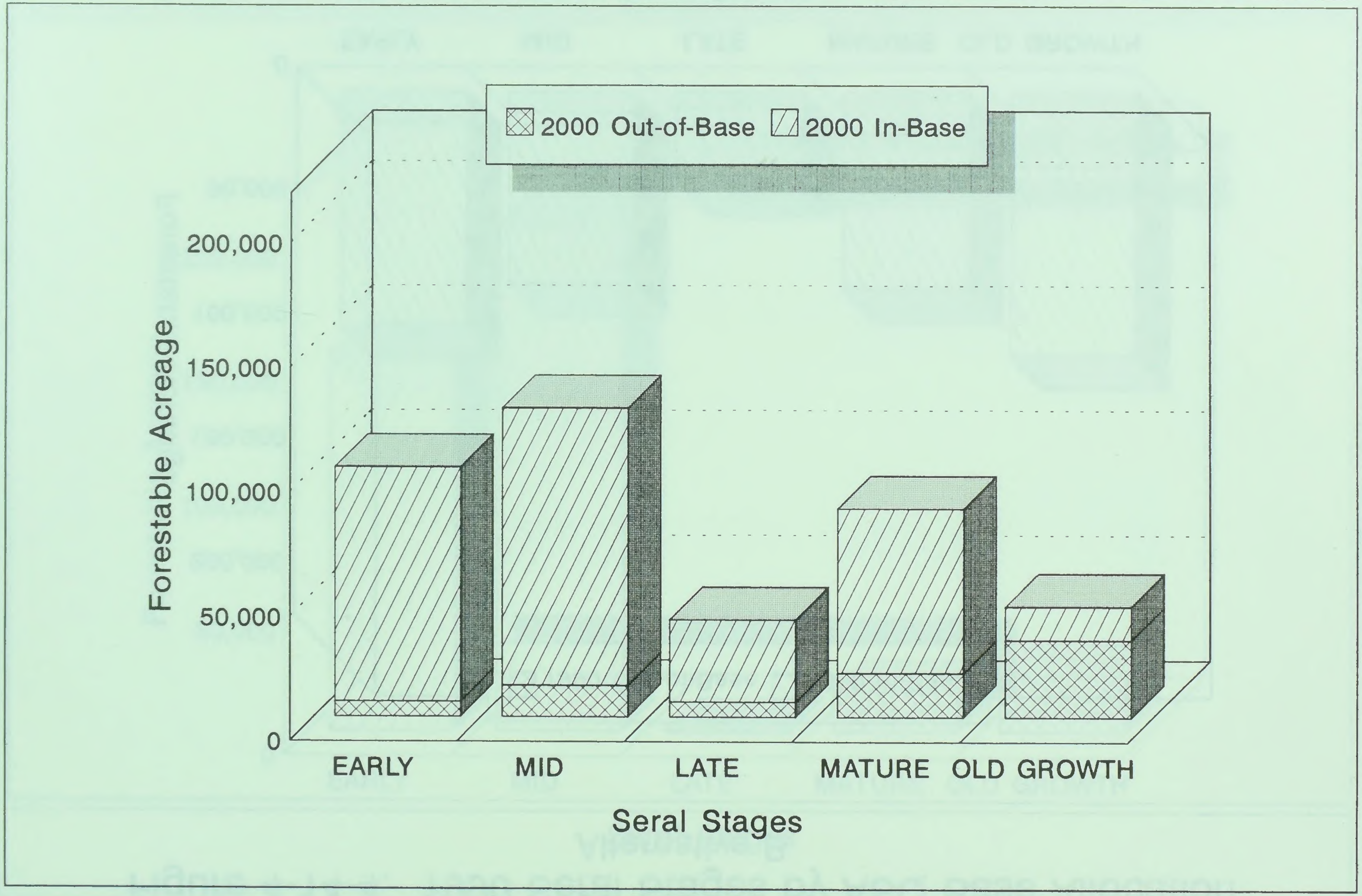


Figure 4-14-6. 2090 Seral Stages by ASQ Base Allocation
Alternative B

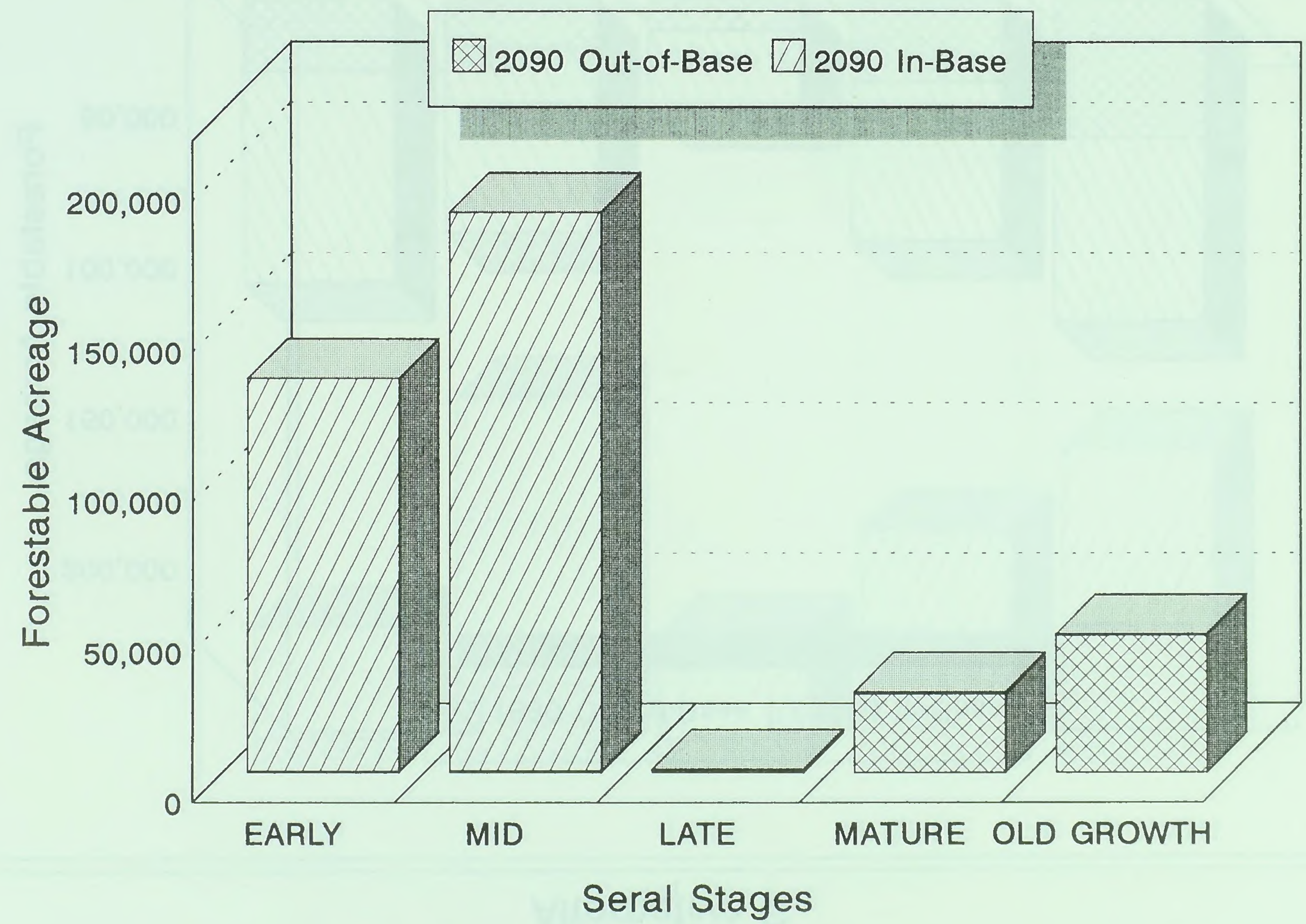


Figure 4-14-7. 1990 Seral Stages by ASQ Base Allocation
Alternative C

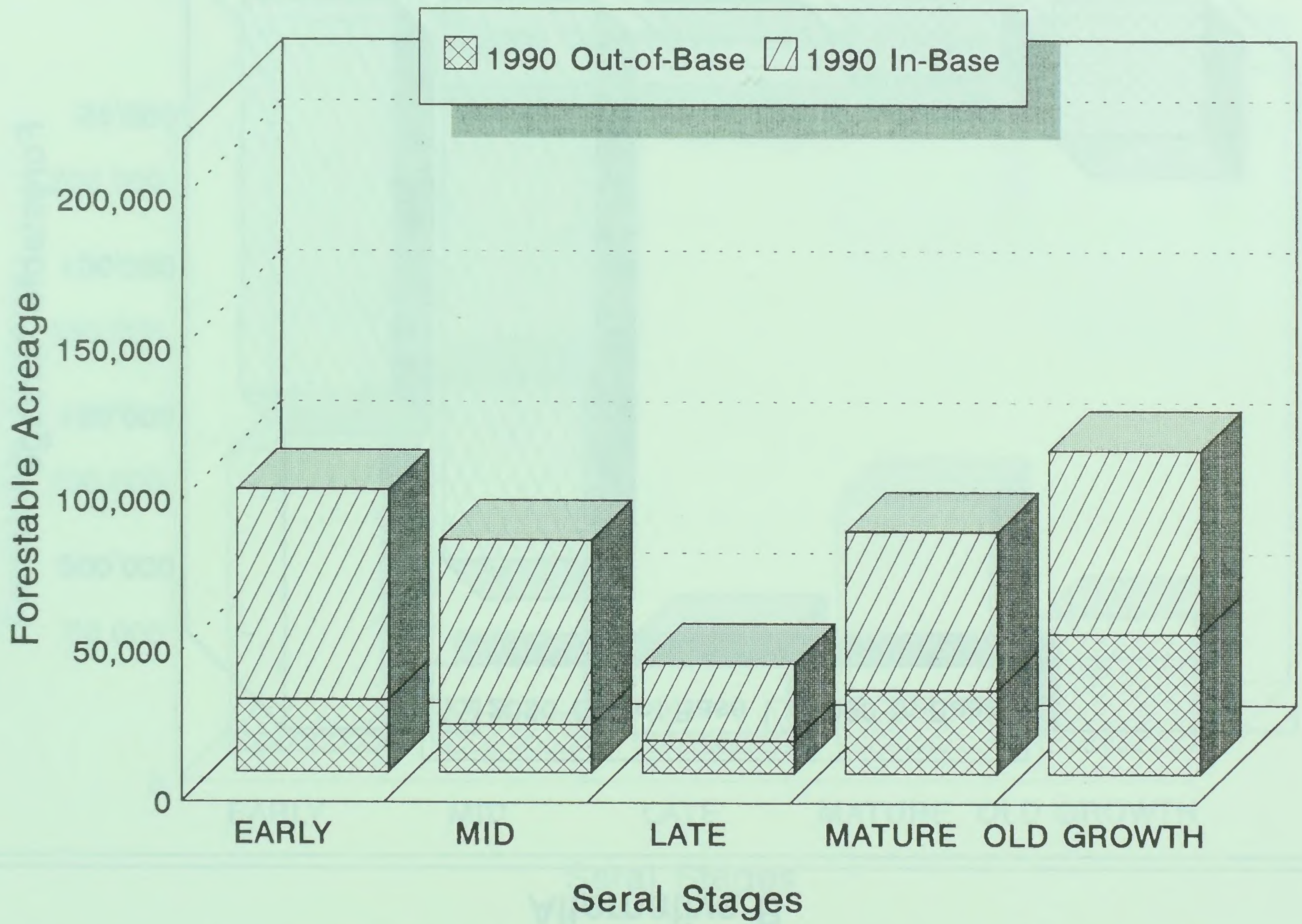


Figure 4-14-8. 2000 Seral Stages by ASQ Base Allocation Alternative C

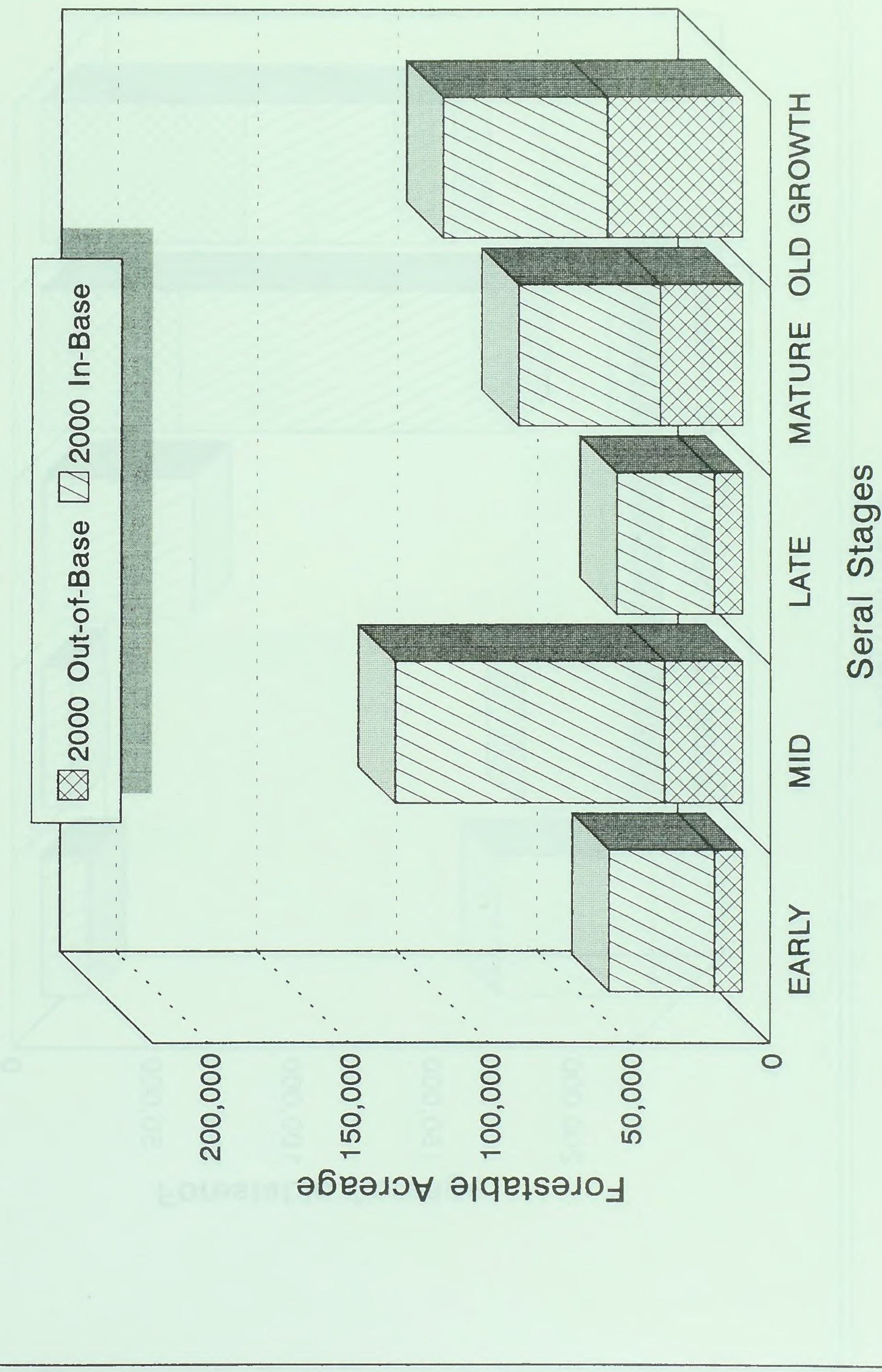


Figure 4-14-9. 2090 Seral Stages by ASQ Base Allocation
Alternative C

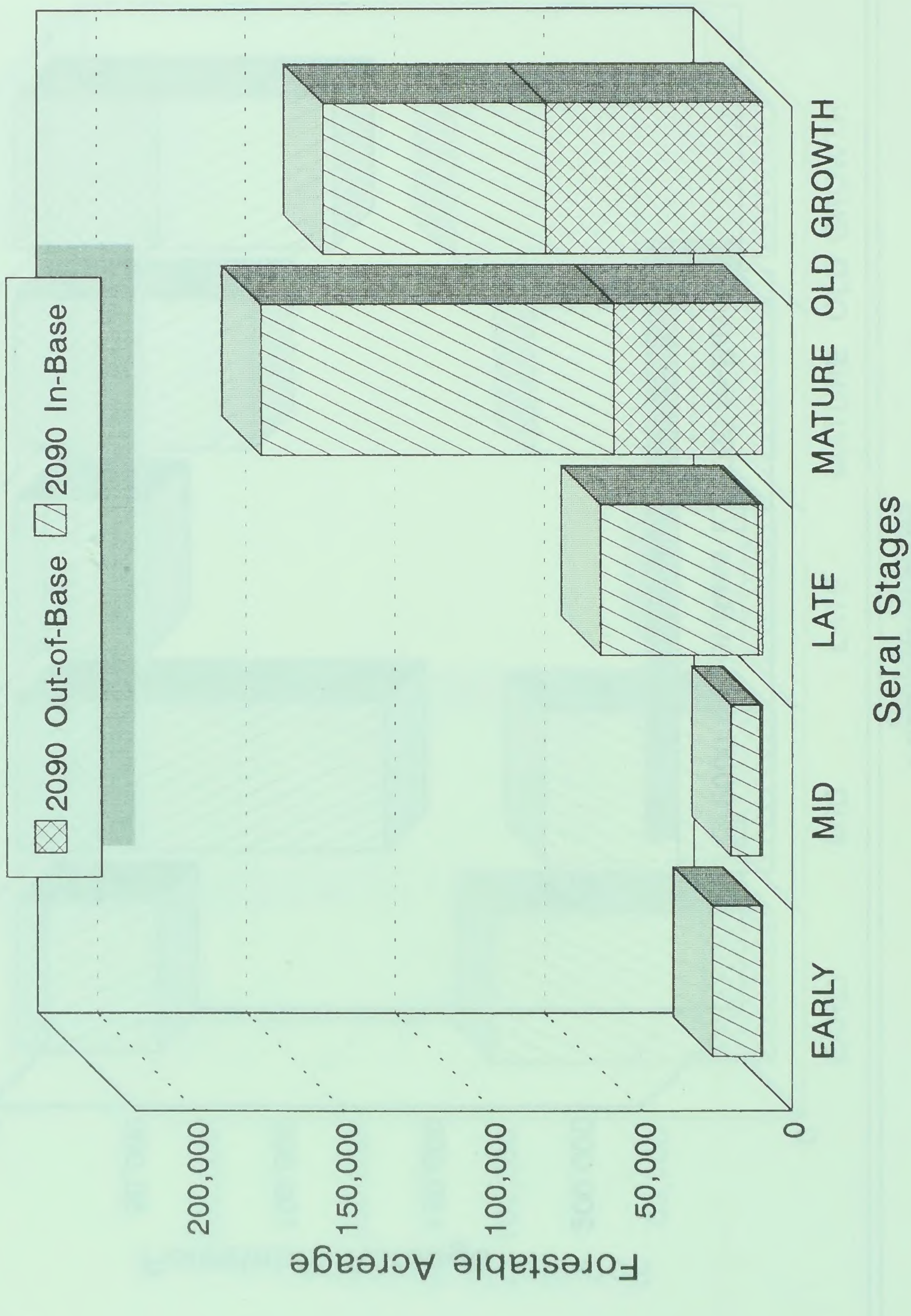


Figure 4-14-10. 1990 Seral Stages by ASQ Base Allocation
Alternative D

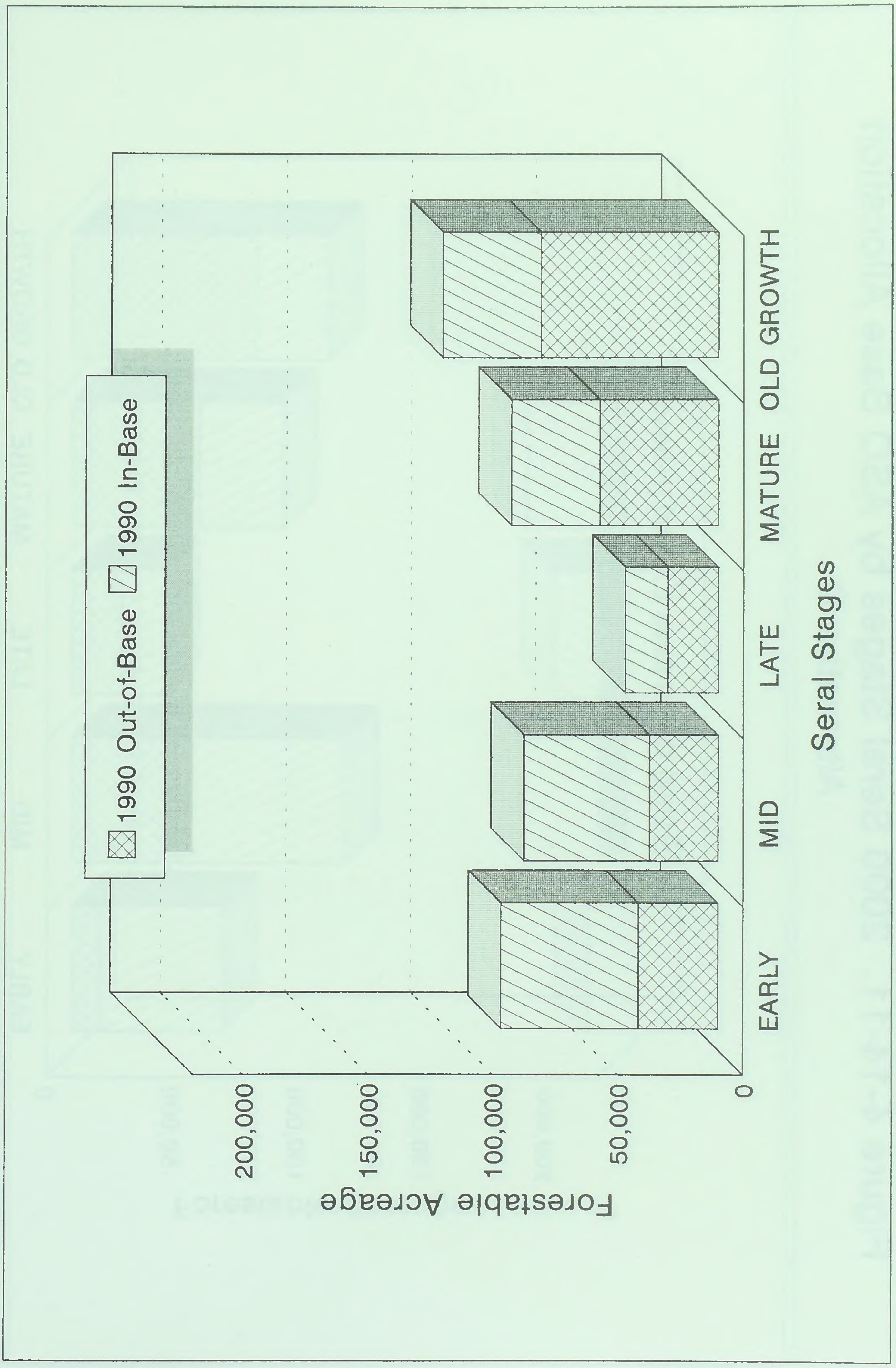


Figure 4-14-11. 2000 Seral Stages by ASQ Base Allocation
Alternative D

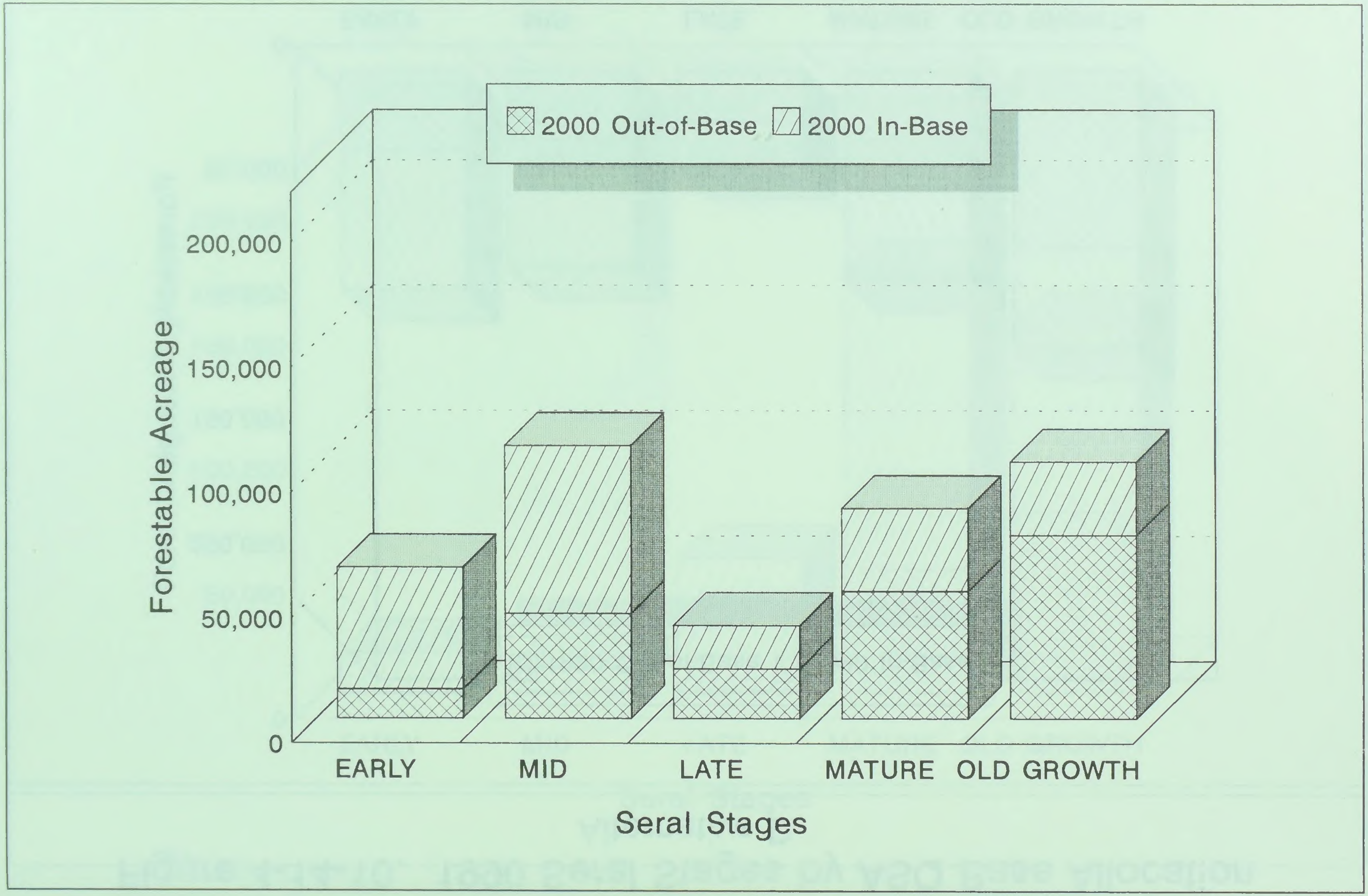


Figure 4-14-12. 2090 Seral Stages by ASQ Base Allocation
Alternative D

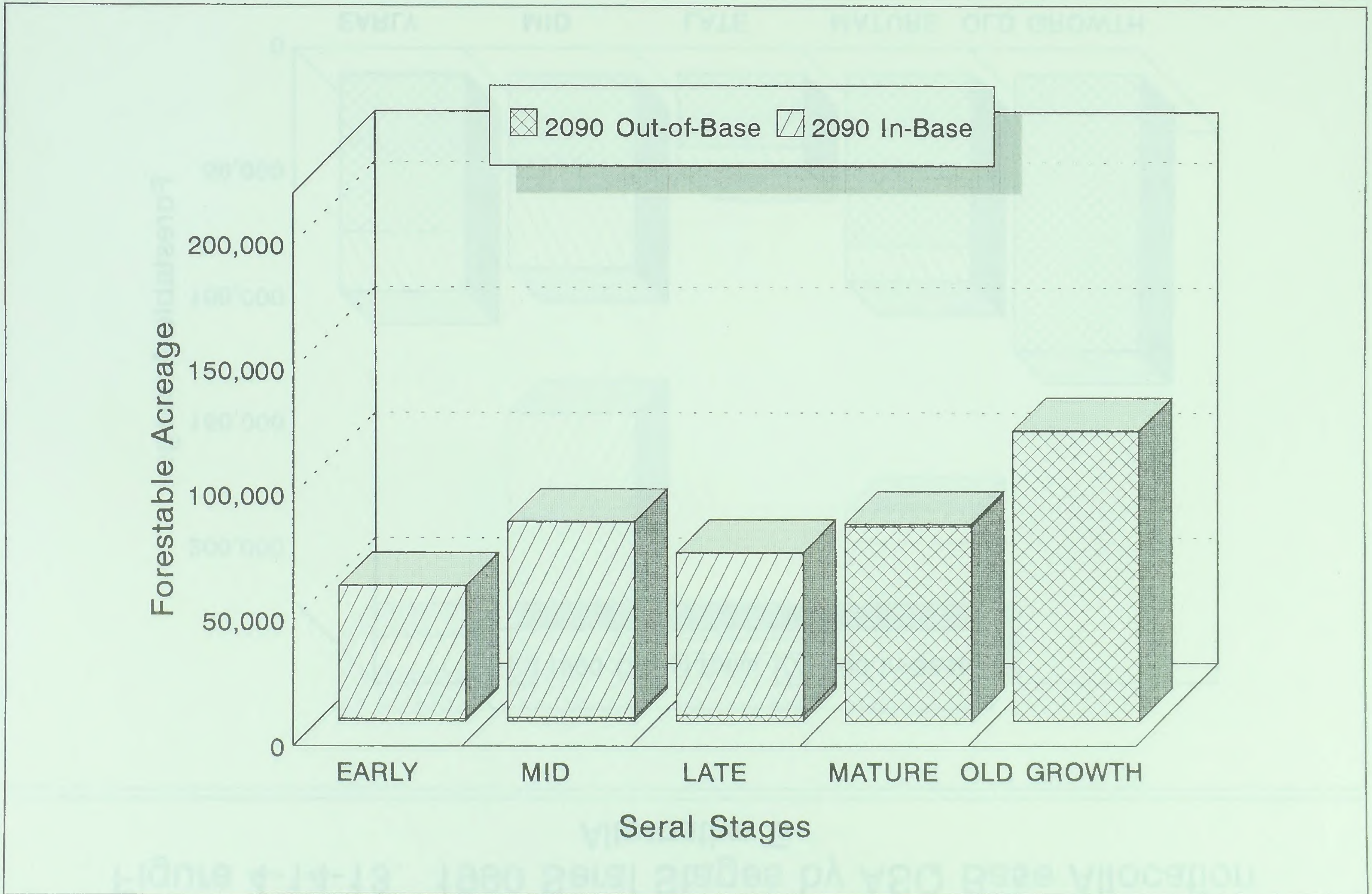


Figure 4-14-13. 1990 Seral Stages by ASQ Base Allocation
Alternative E

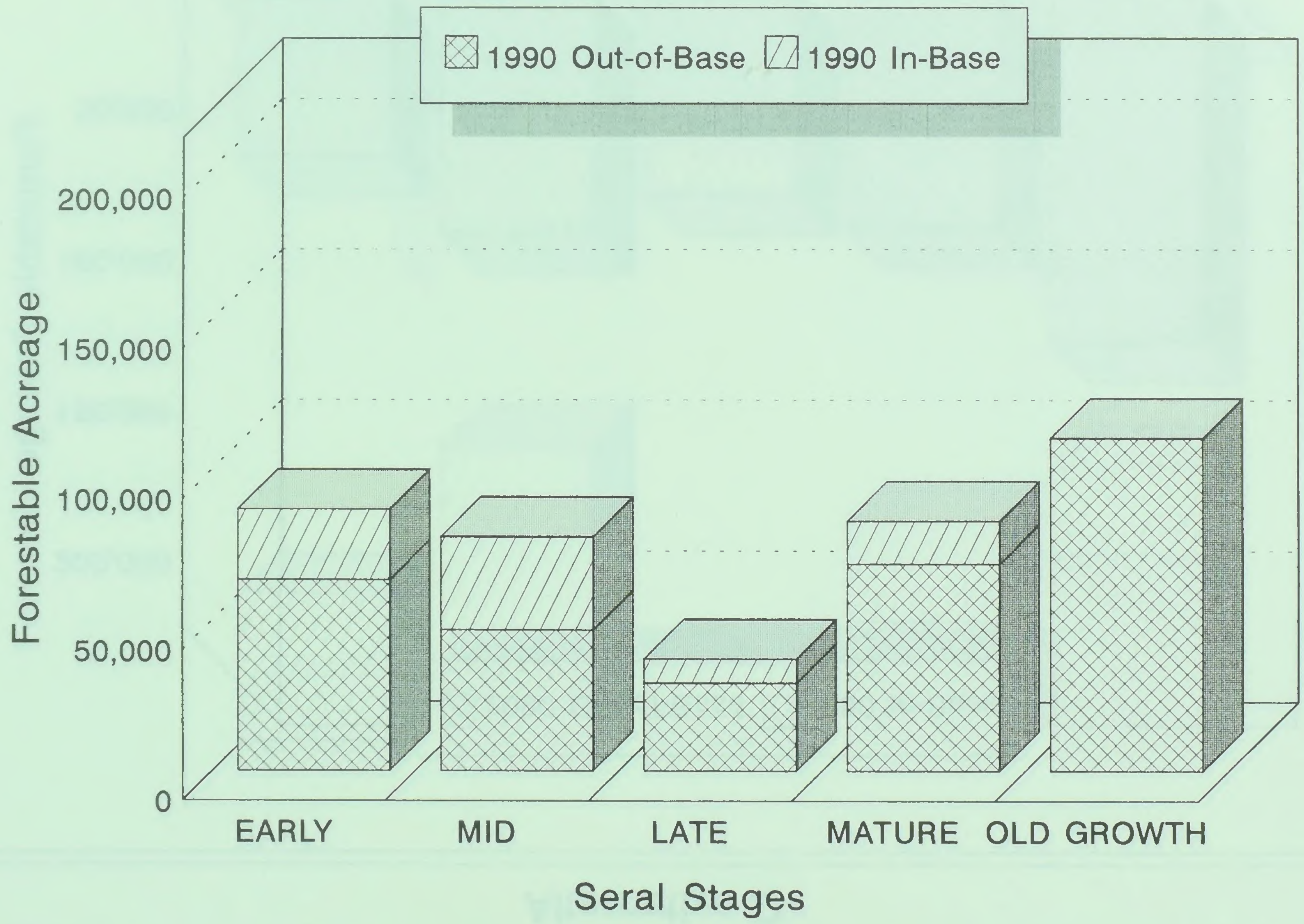


Figure 4-14-14. 2000 Seral Stages by ASQ Base Allocation
Alternative E

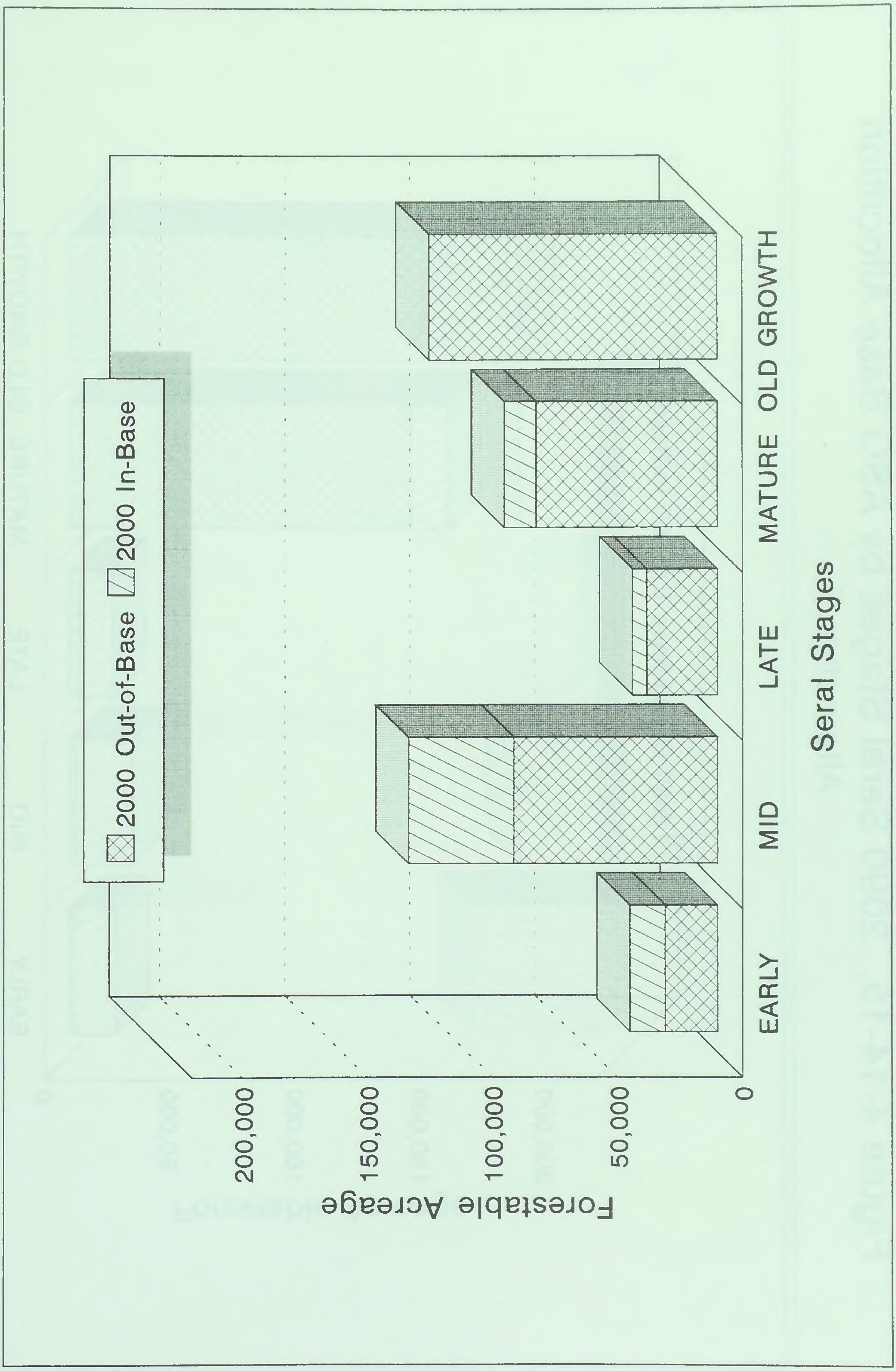


Figure 4-14-15. 2090 Seral Stages by ASQ Base Allocation
Alternative E

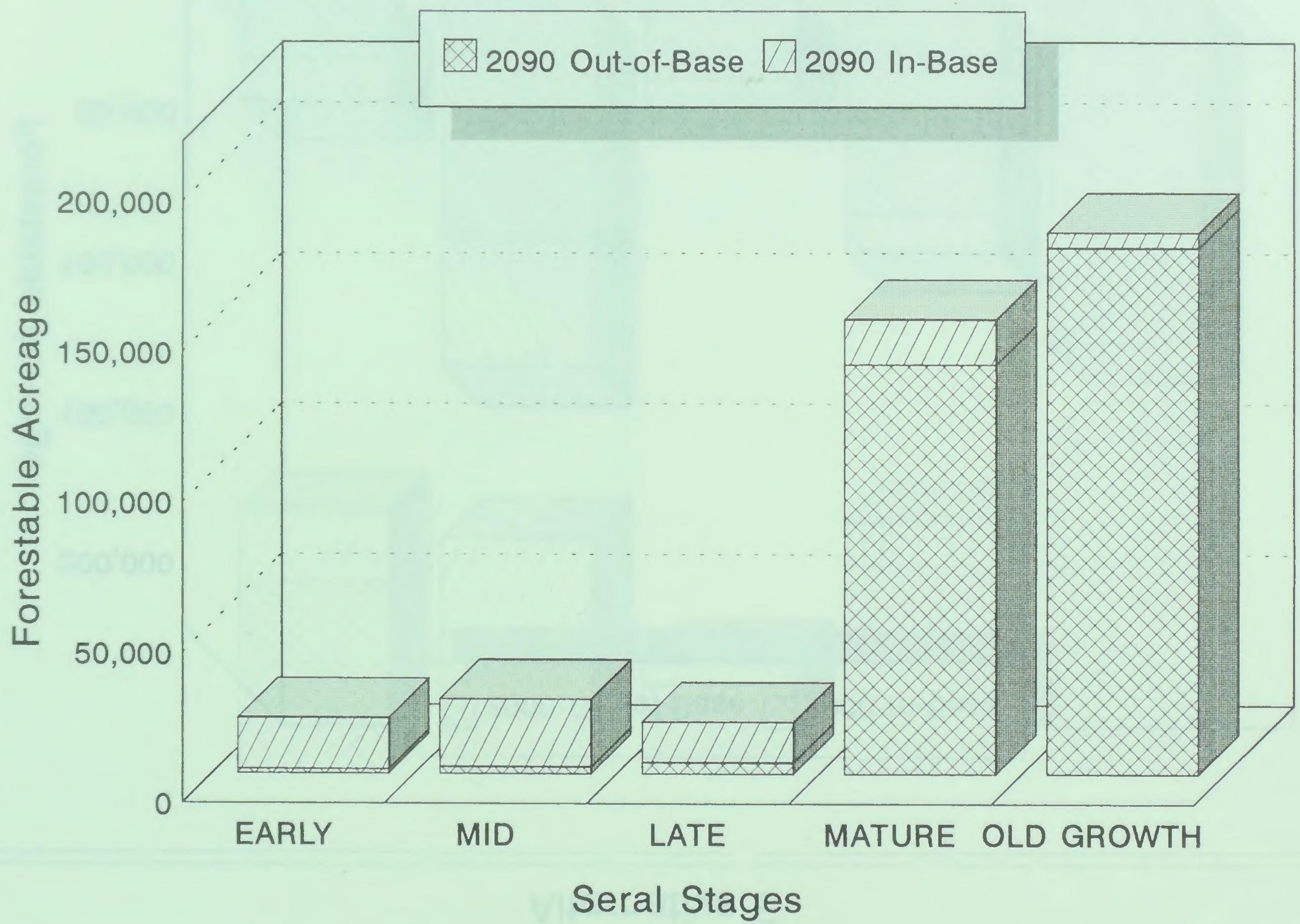


Figure 4-14-16. 1990 Seral Stages by ASQ Base Allocation
Preferred Alternative

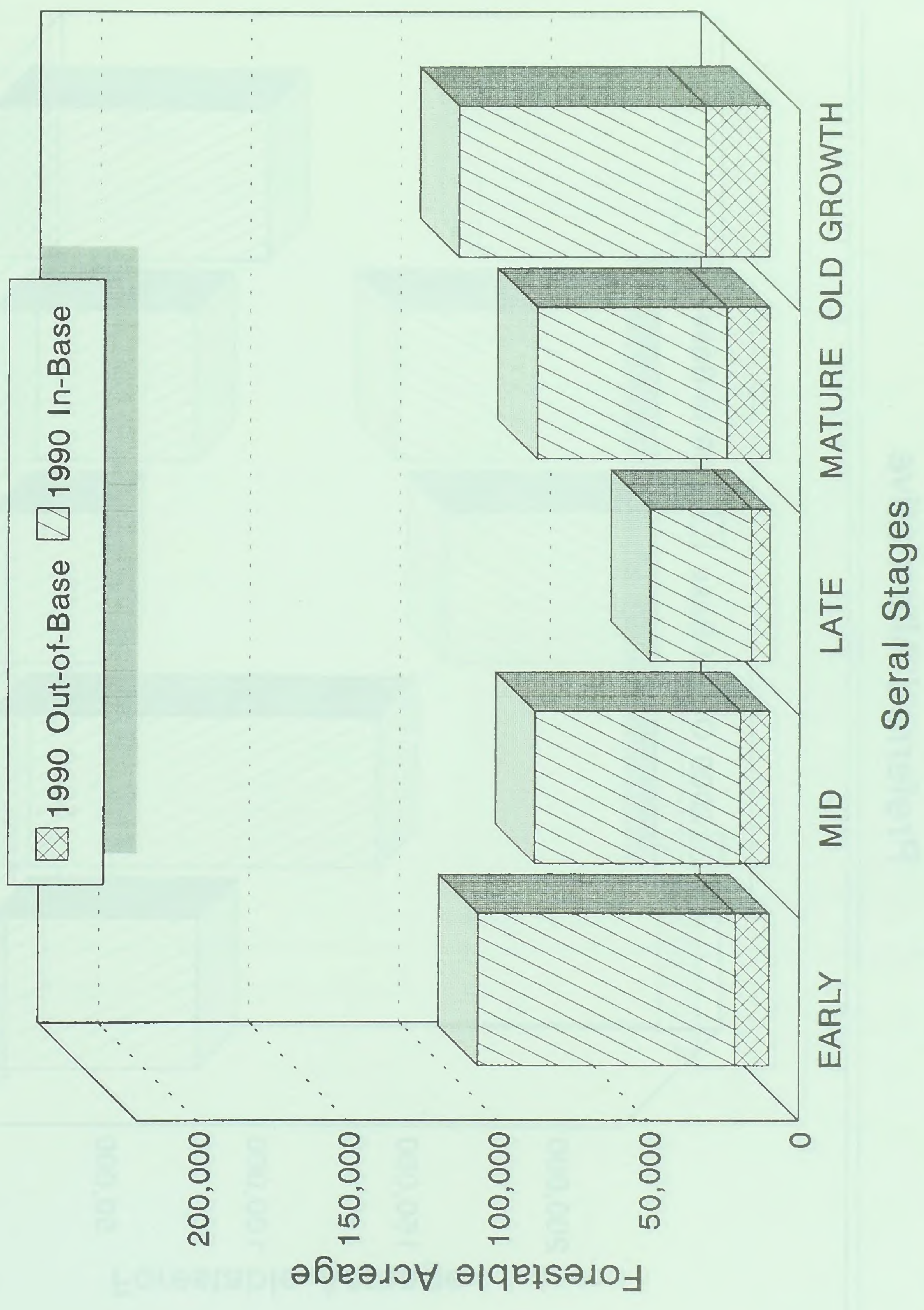


Figure 4-14-17. 2000 Seral Stages by ASQ Base Allocation
Preferred Alternative

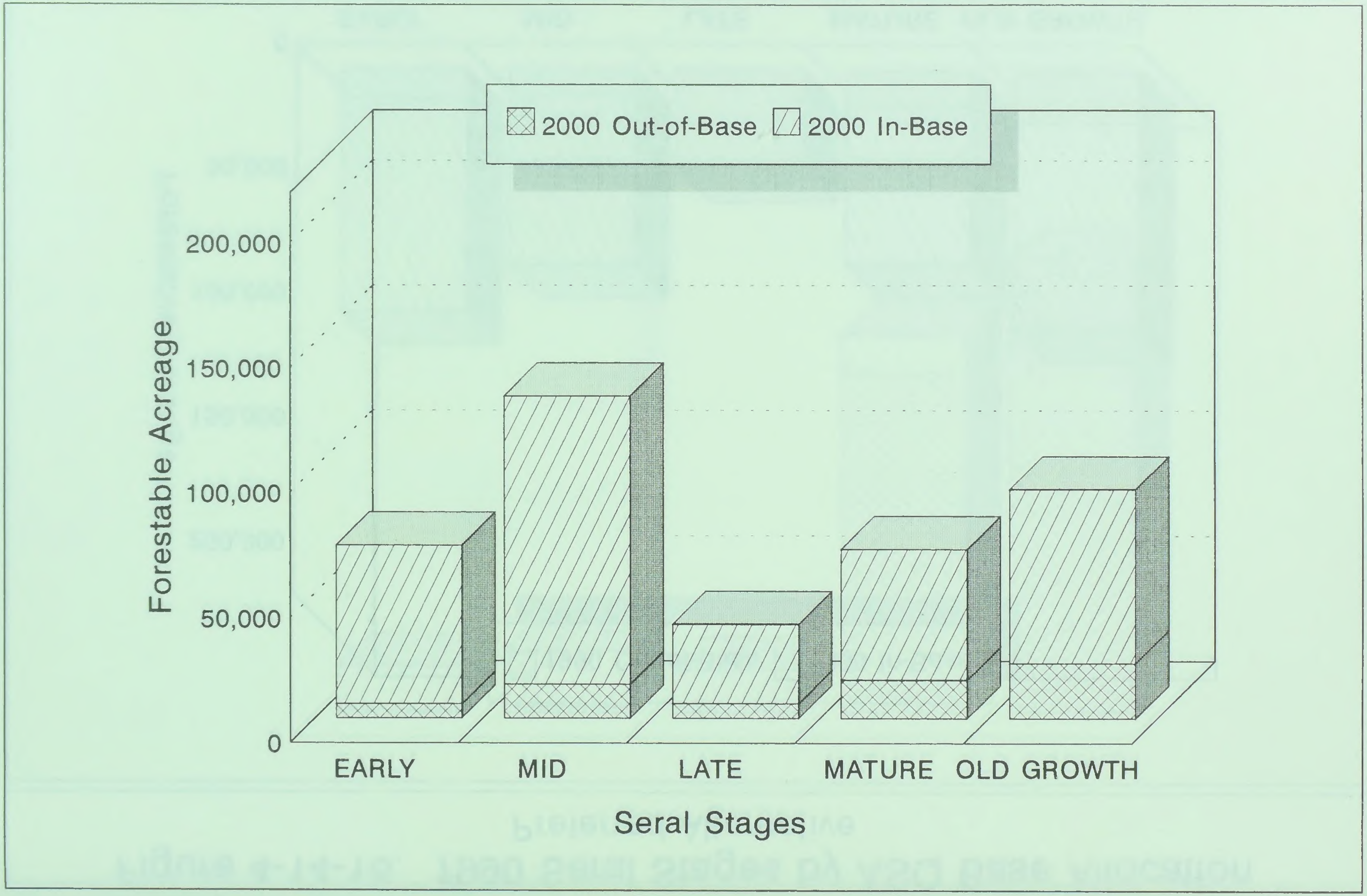
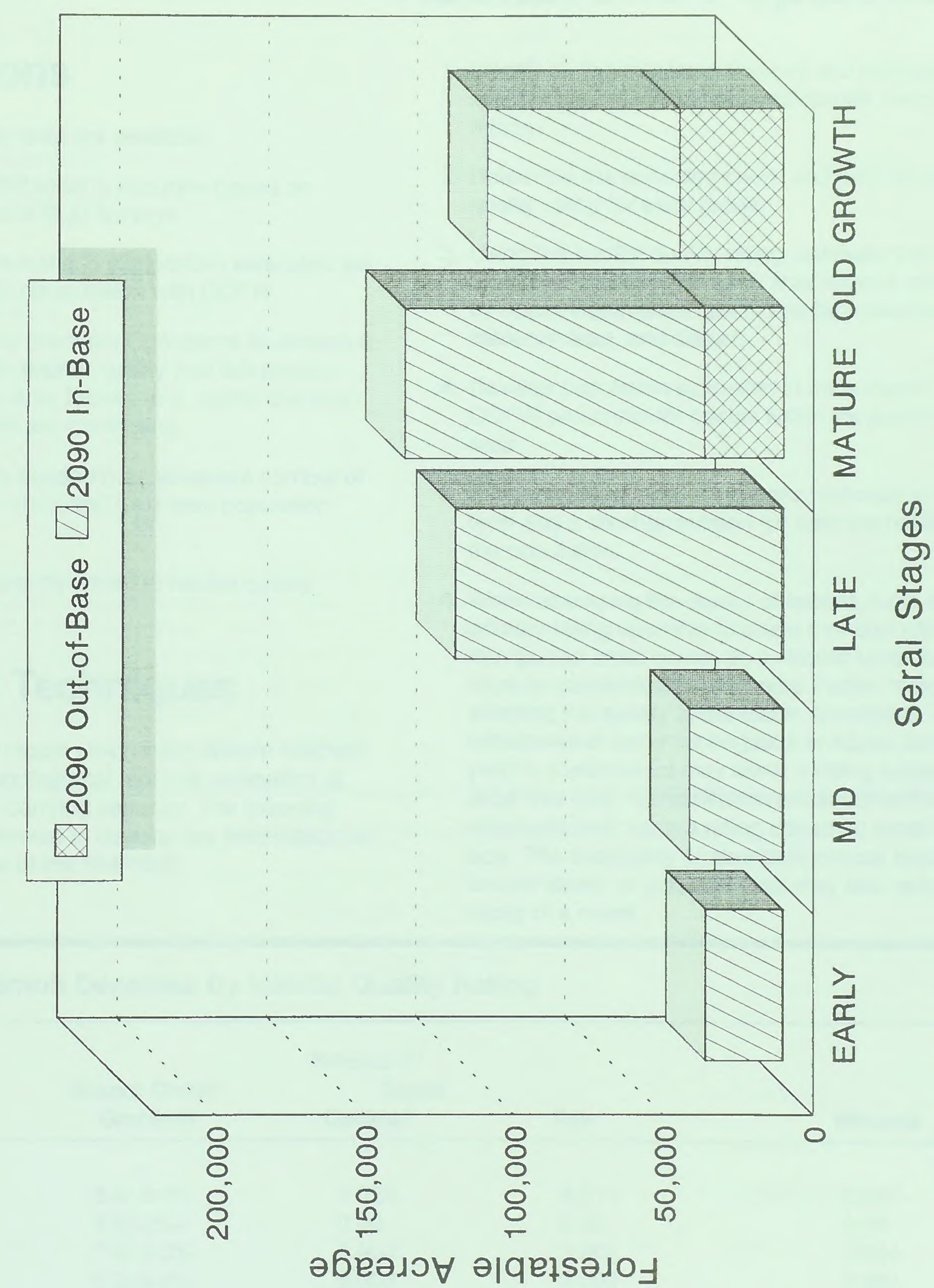


Figure 4-14-18. 2090 Seral Stages by ASQ Base Allocation
Preferred Alternative



Appendix 4-15
Methodology for Assessing Effects on Fish Habitat and Populations

Assumptions

1. Stream inventory data are available.

2. Fish species distribution is accurate based on current ODFW and BLM surveys.

3. Fish density, survival and exploitation estimates are provided through consultation with ODFW.

4. Riparian tree size (from the Operations Inventory) is directly related to habitat quality and fish populations, assuming other factors (e.g., water diversion or sedimentation) are not limiting.

5. Streams are fully seeded (i.e., adequate number of adult fish) under short and long-term population estimates.

6. Food supply is directly linked to habitat quality rating.

Analytical Techniques

The habitat quality model which rates stream reaches as minimal, fair, good/optimal requires estimation of species population carrying capacity. The following steps should be followed to develop the information for the fisheries portion of the RMP/EIS.

1. Identify all fish inhabited reaches and segregate by species (use reach attributes to identify every reach).

2. Determine the expected short- and long-term habitat quality rating for each reach.

3. Using the habitat quality rating, estimate the smolt production capacity for each anadromous species by reach. Summarize reach data by watershed, resource area, and district.

4. Develop population estimates in consultation with ODFW personnel for basins within the planning area.

5. Using projected habitat changes, estimate a long-term and a short-term trend for both the habitat and the population.

6. When assessing the quality of habitat, base the primary rating upon the average tree size (dbh) in the riparian area. However, a related factor analysis must be conducted to determine if other factors are affecting the quality of the reach. Examples: The withdrawal of water for irrigation or heavy sediment yield in a watershed may lower a rating based on large tree size. Rehabilitation/enhancement with structures may raise a rating based on small tree size. The availability of abundant natural structure, beaver dams, or side channels may also raise the rating of a reach.

Table 4-15-1. Smolt Densities By Habitat Quality Rating

Species	Stream Order/ Gradient	Smolts/ft[1] Good/ Optimal	Fair	Minimal
Coho salmon	2-6/ 0-3%	0.028	0.014	0.007
	2-5/ 3%+	0.00	0.00	0.00
	7-9/ 0-3%	0.003	0.002	0.001
Steelhead	2-5/ 0-3%	0.003	0.002	0.001
	2-5/ 3%+	0.007	0.004	0.002
	6-9/ 0-3%	0.002	0.001	0.0005
Cutthroat trout	2-5/ 0-3%	0.0015	0.001	0.0005
	2-5/ 3%+	0.0035	0.002	0.001
	6-9/ 0-3%	0.001	0.0005	0.00025

Table 4-15-1. Smolt Densities By Habitat Quality Rating (cont.)

Chinook salmon		Smolts (migrants)/ft[1]		
Spring chinook	Any stream reach used annually as spawning and rearing habitat	0.011	0.006	0.003
Fall chinook	Any stream reach used annually for spawning and early rearing; usually 4th order and higher streams with less than 3% gradient	0.04	0.02	0.01
Spring and fall chinook	Any stream reach used by spring and fall chinook; average smolt production value was used.	0.026	0.013	0.006

[1] In addition to the other habitat characteristics used to describe chinook salmon habitat quality for each stream reach, the amount of suitable spawning area that applies to each category is as follows:
Good/Optimal - 25 percent or more
Fair - 10-24 percent
Minimal - Less than 10 percent
Fall chinook rear for only a short time in spawning tributaries and most mainstream spawning areas.

Smolt densities were determined collectively with the Oregon Department of Fish and Wildlife. Considerable natural variability in fish production occurs between years and between streams. For example, a 20 percent variability in coho smolt production occurred in Deer Creek during different years, and the observed range of coho smolts produced per mile in different streams was 453 to 2,110 (Beidler, et al, 1980) due to different habitat conditions (e.g., stream width, gradient, percent pools, etc.).

Table 4-15-2. Smolt Survival & Exploitation (Fishing) Rates

	Percent of Population	
Species	Smolt Survival to Adult	Fishing Rate[1]
Coho	7.5	69
Steelhead	10.0	30
Cutthroat	30.0	20
Chinook		
• Spring	10.0	60
• Fall	9.0	60

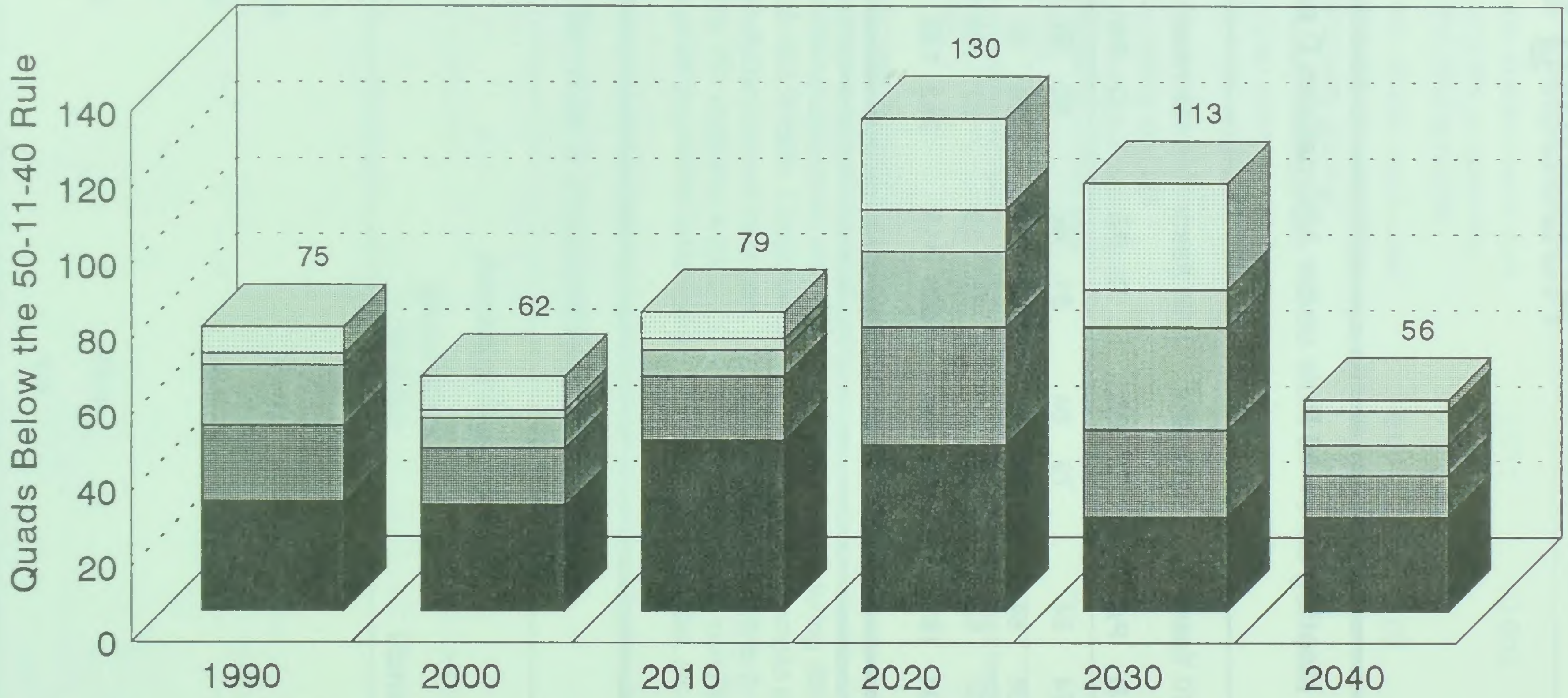
[1] The percentage of adult fish caught through commercial and sport fishing.

Appendix 4-16
50-11-40 Analysis of the Roseburg District

Table 4-16-1 Quarter Townships Meeting 50-11-40 Rule under Alternatives D and PA In the Roseburg District

	Total 1/4 Twps	Present	10 Years D	10 Years PA	20 Years D	20 Years PA	30 Years D	30 Years PA	40 Years D	40 Years PA	50 Years D	50 Years PA
Coast Range	83	61	74	64	79	64	81	46	83	52	83	69
Klamath	79	63	68	64	74	47	73	34	79	38	79	52
W. Cascade	81	44	62	53	76	53	81	39	81	40	81	66
Total	**243**	**168**	**204**	**181**	**229**	**164**	**235**	**113**	**243**	**130**	**243**	**187**

Figure 4-16-1. Quarter Townships Not Meeting the 50-11-40 Rule Quads by Decade within the GFMA and Connectivity Areas Preferred Alternative - Roseburg District

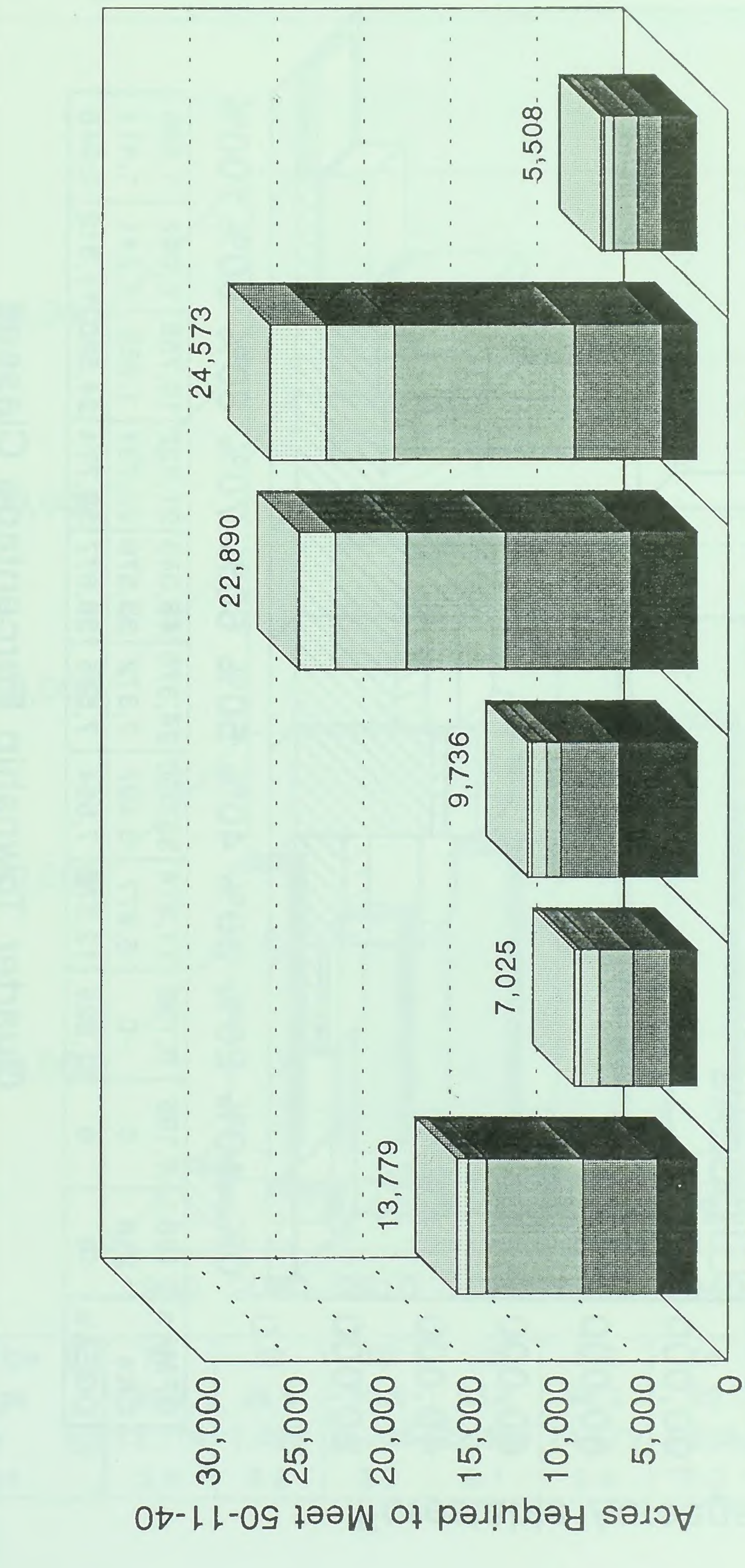


	1990	2000	2010	2020	2030	2040
0-9%	7	9	7	24	28	3
10-19%	3	2	3	11	10	9
20-29%	16	8	7	20	27	8
30-39%	20	15	17	31	23	11
40-49%	29	28	45	44	25	25

Number of Quarter Townships Ranked by 50-11-40 Rule

Total number of Quads is 243

Figure 4-16-2. Quarter Townships Not Meeting the 50-11-40 Rule Acreage by Decade within the GFMA and Connectivity Areas Preferred Alternative - Roseburg District

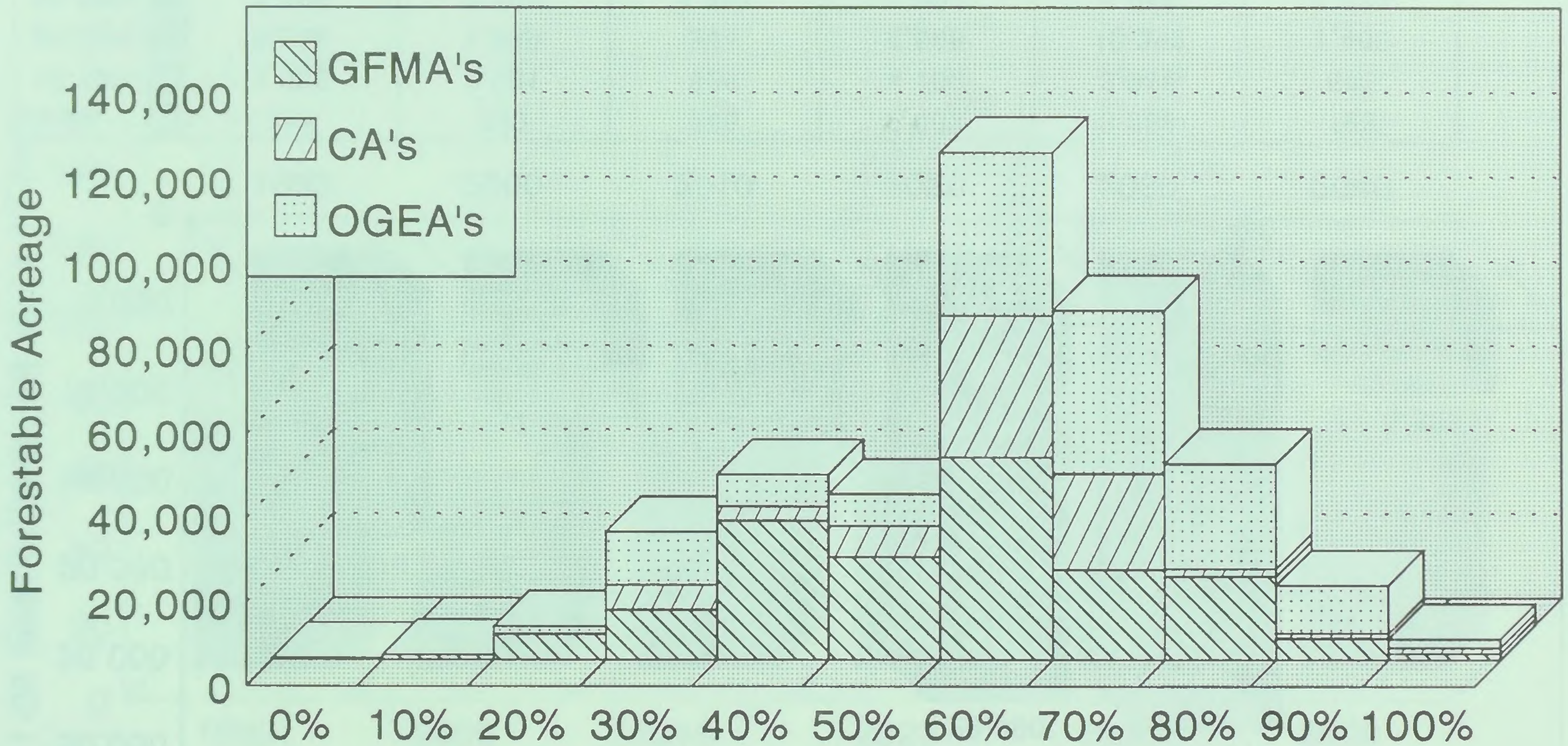


	1990	2000	2010	2020	2030	2040
0-9%	654	343	246	2,082	3,238	193
10-19%	1,056	1,081	825	4,102	3,916	543
20-29%	5,538	1,939	844	5,698	10,392	1,405
30-39%	4,268	2,138	3,357	7,207	5,048	1,372
40-49%	2,263	1,524	4,464	3,801	1,979	1,995

Acreage Needed for Quarter Townships Ranked by 50-11-40 Rule

Total acreage for the GFMA and Connectivity Areas is 250,400

Figure 4-16-3. Roseburg District 50-11-40 Rule
1990 Status Preferred Alternative for Land Allocations

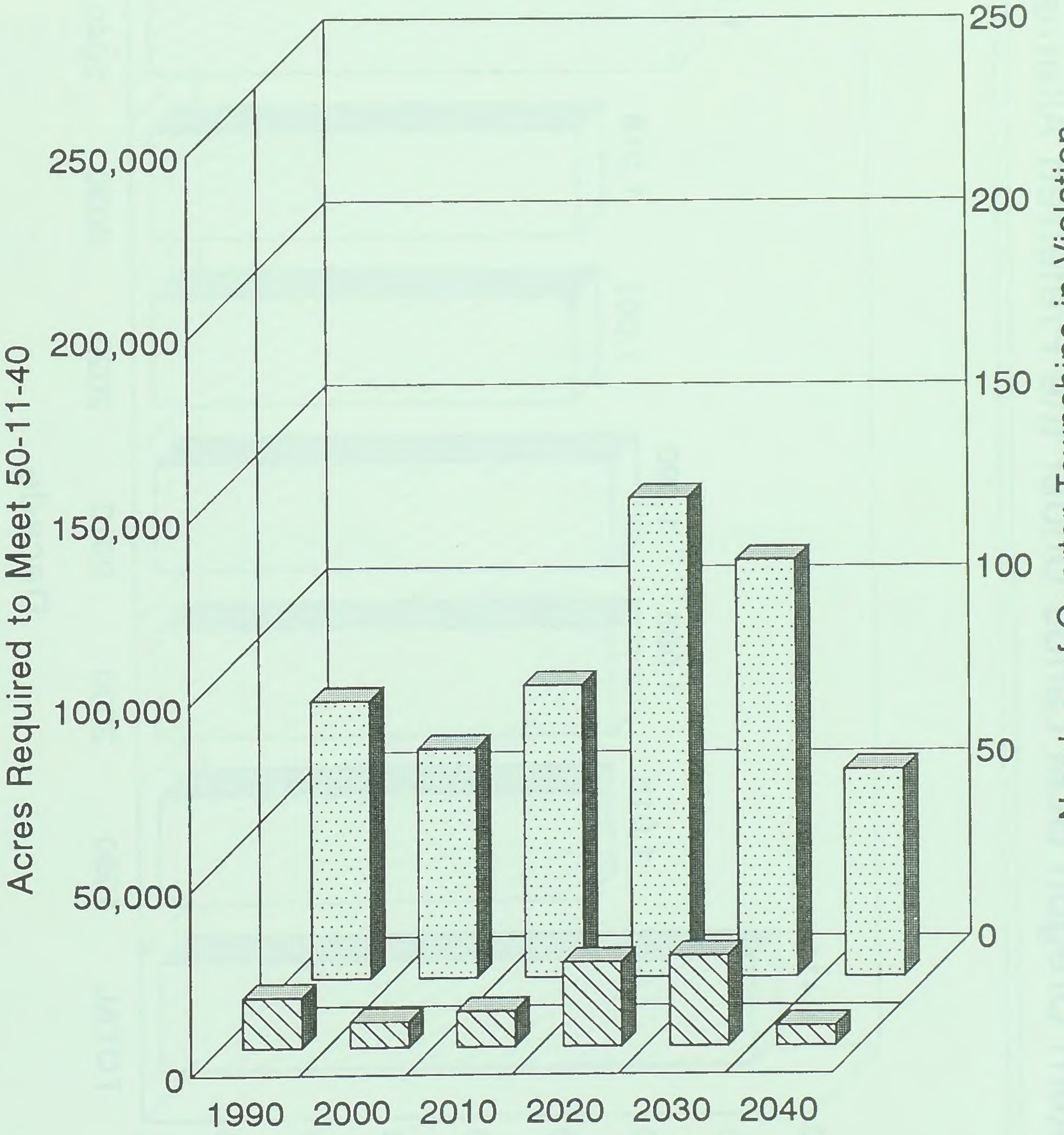


	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
GFMA's	198	1,195	6,138	11,814	33,000	24,375	48,043	21,422	19,755	5,092	1,465
CA's	218	0	0	5,977	3,407	7,372	33,676	22,737	1,856	1,241	1,411
OGEA's	0	0	1,824	12,578	7,554	7,545	38,677	38,774	24,880	11,312	2,046

Quarter Township Percentage Classes

GFMA: General Forest Management Areas
CA: Connectivity Areas
OGEA: Old Growth Emphasis Areas

Figure 4-16-4. Roseburg District
Quarter Townships Not Meeting 50-11-40 And Acreage Required to Meet 50-11-40 by Decade

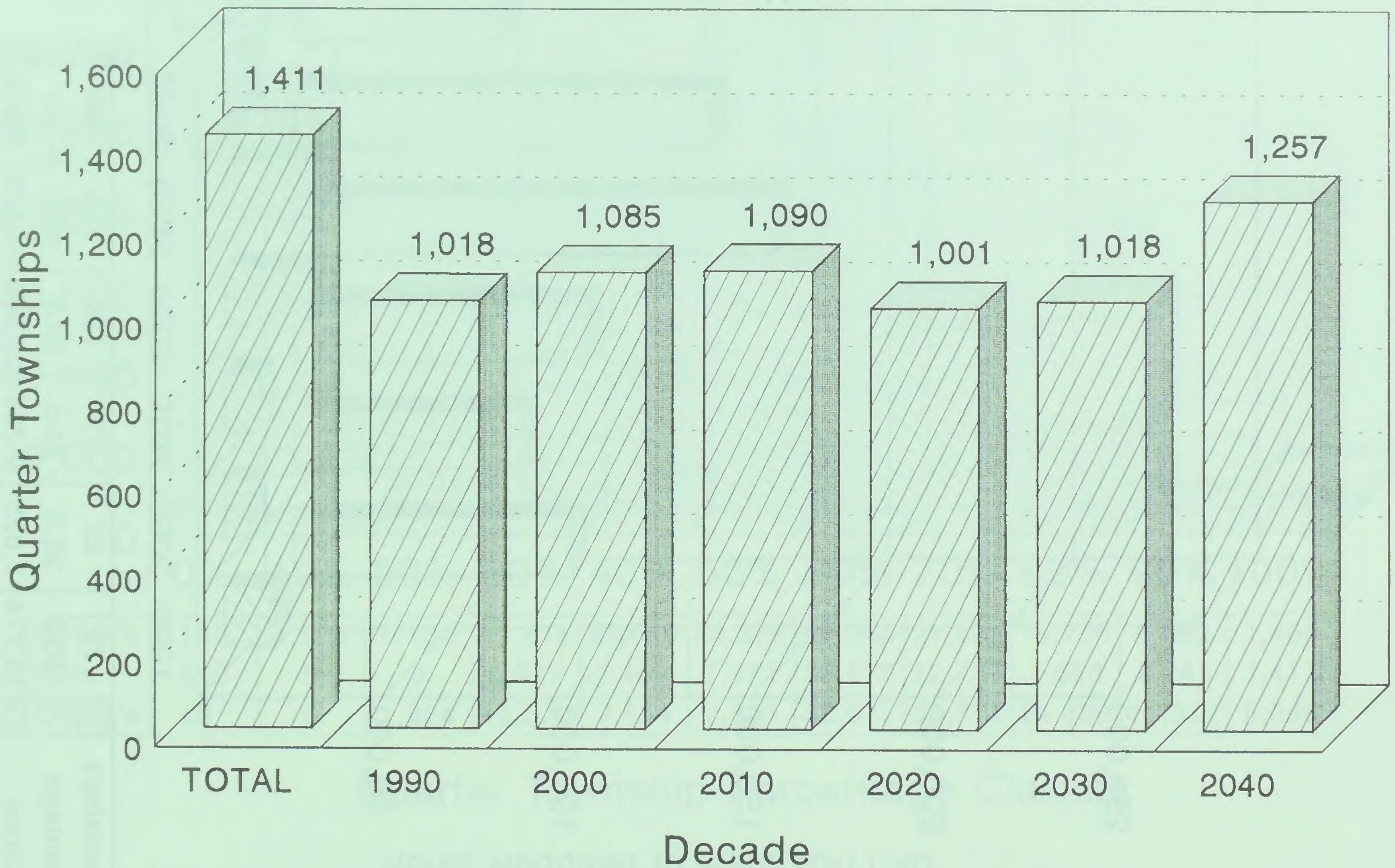


	1990	2000	2010	2020	2030	2040
Quarter Townships	75	62	79	130	113	56
Quad Percentage	30.9	25.5	32.5	53.5	46.5	23
Acres Required	13,774	7,025	9,736	22,890	24,573	5,508
Acreage Percent	5.5	2.8	3.9	9.1	9.8	2.2

Total number of Quarter Townships for the Roseburg district is 243

Total acreage under the Preferred Alternative for the GFMA and Connectivity Areas is 250,400

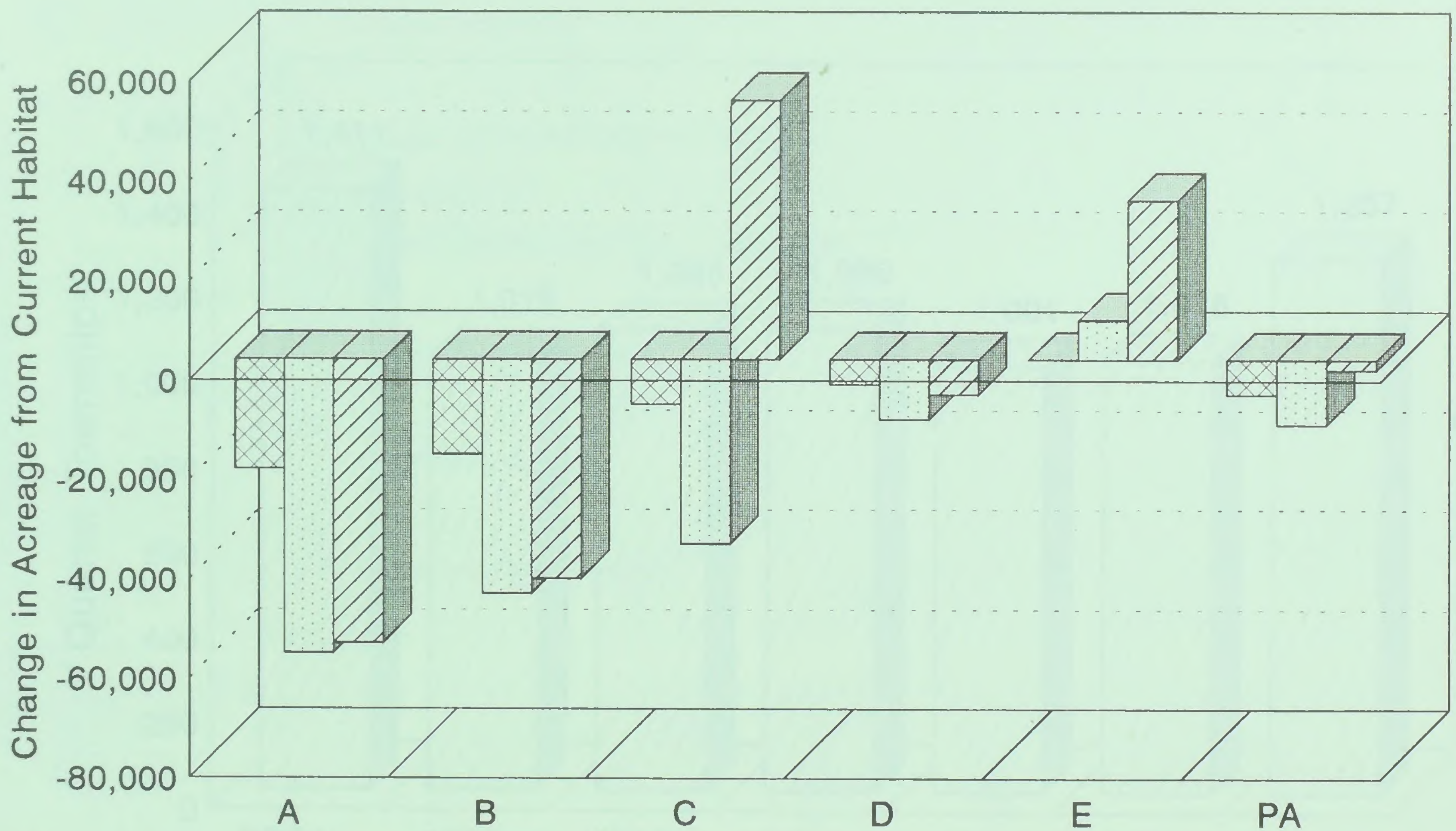
Figure 4-16-5. Quarter Townships Meeting the 50-11-40 Rule
Western Oregon BLM Lands Under the Preferred Alternative



Twenty-two Quarter Townships lack the potential to meet the 50-11-40 Rule due to natural stand conditions remaining below 40% canopy closure.

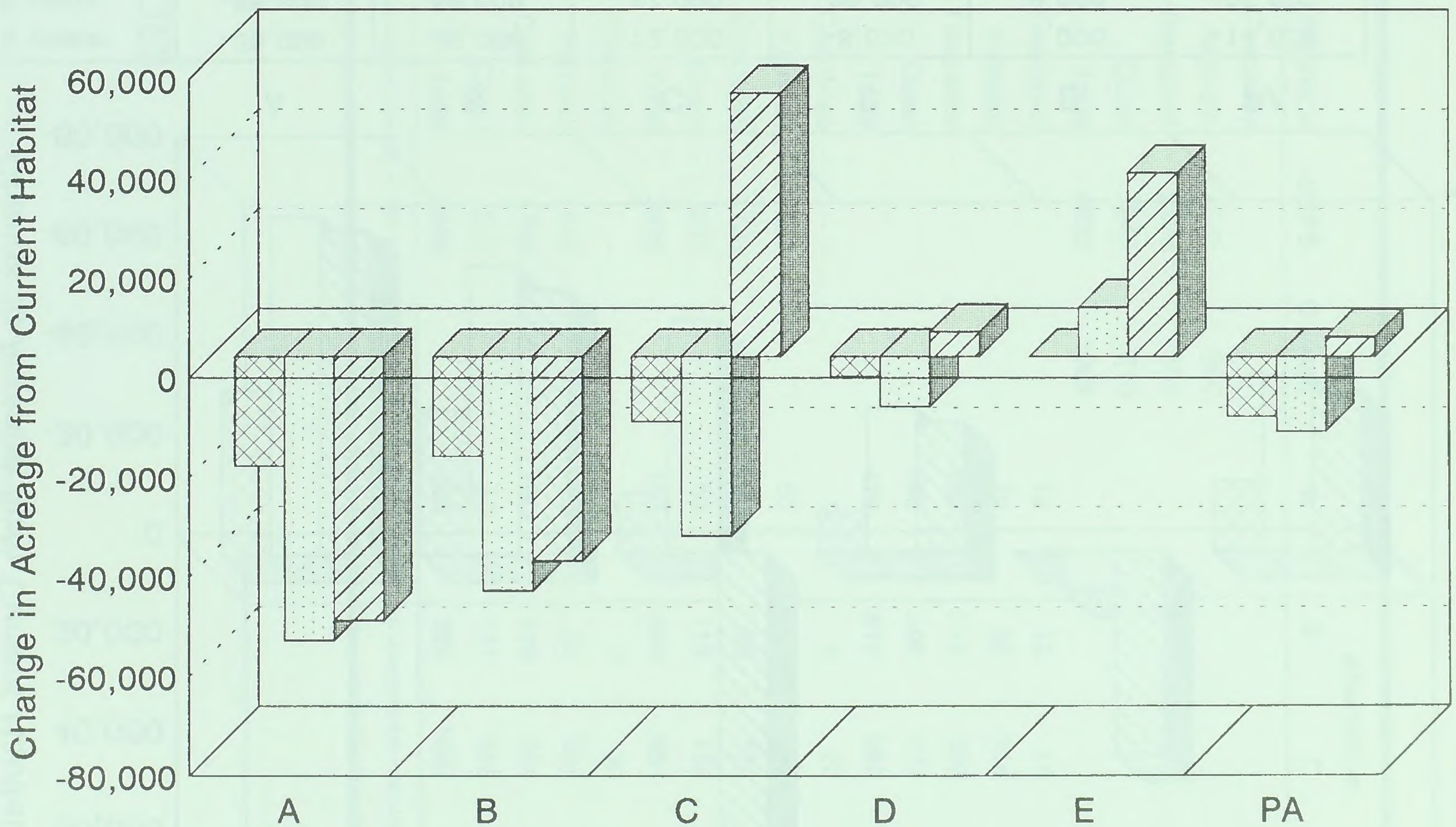
Appendix 4-17
Changes in Suitable Spotted Owl Habitat by Alternative by Province

Figure 4-17-1. Changes in Suitable Spotted Owl Habitat by Alternative
Coast Range Province - BLM Lands - Roseburg District



	A	B	C	D	E	PA
After 10 years	-22,000	-19,000	-9,000	-5,000	0	-7,000
After 50 years	-59,000	-47,000	-37,000	-12,000	8,000	-13,000
After 100 years	-57,000	-44,000	52,000	-7,000	32,000	-2,000

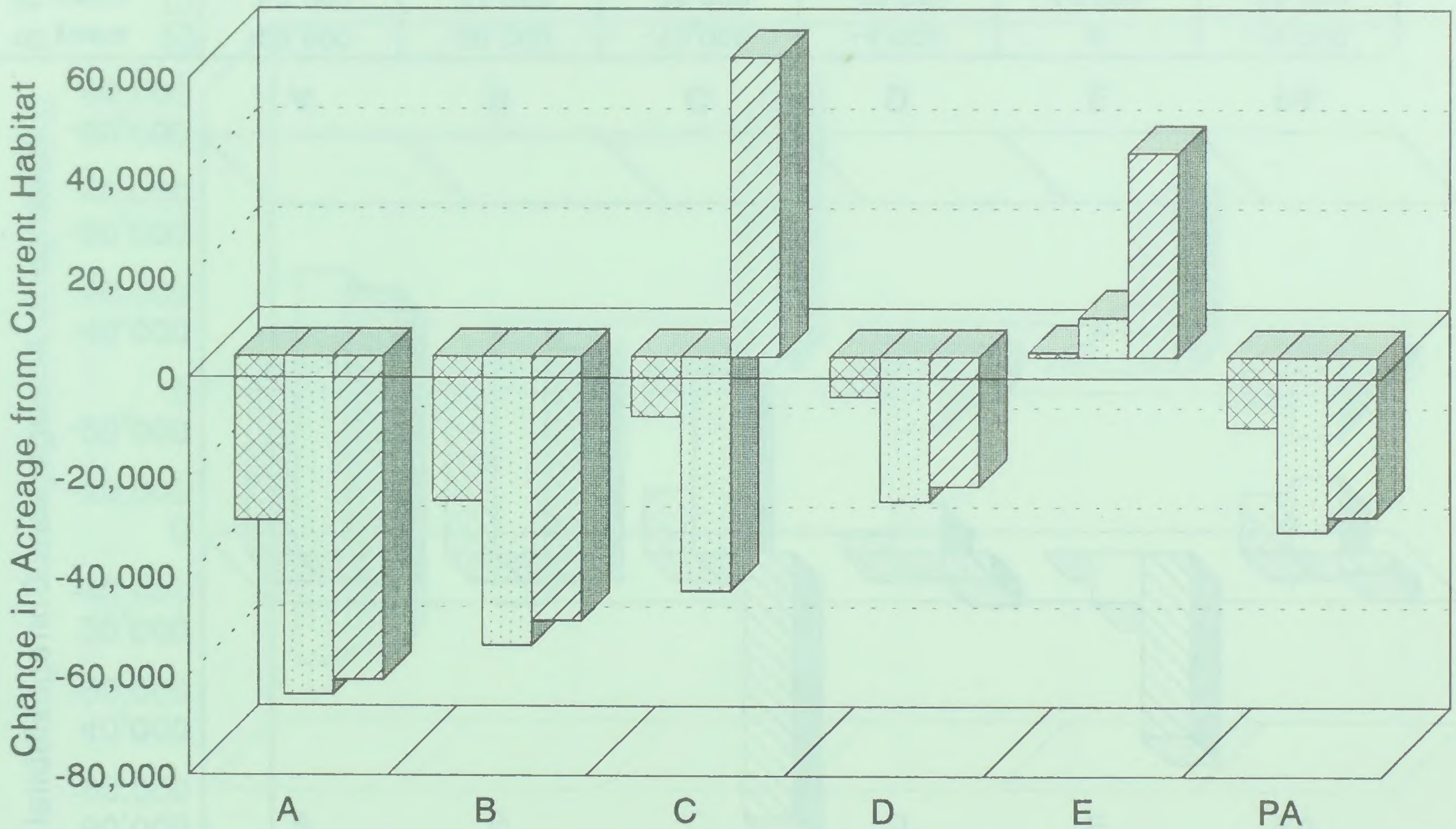
Figure 4-17-2. Changes in Suitable Spotted Owl Habitat by Alternative
Klamath Province - BLM Lands - Roseburg District



	A	B	C	D	E	PA
After 10 years	-22,000	-20,000	-13,000	-4,000	0	-12,000
After 50 years	-57,000	-47,000	-36,000	-10,000	10,000	-15,000
After 100 years	-53,000	-41,000	53,000	5,000	37,000	4,000

Figure 4-17-3. Changes in Suitable Spotted Owl Habitat by Alternative

Western Cascades Province - BLM Lands - Roseburg District



	A	B	C	D	E	PA
After 10 years	-33,000	-29,000	-12,000	-8,000	1,000	-14,000
After 50 years	-68,000	-58,000	-47,000	-29,000	8,000	-35,000
After 100 years	-65,000	-53,000	60,000	-26,000	41,000	-32,000

Appendix 4-18
Western Oregon
Spotted Owl Habitat: BLM and USFS

Decade	Province	USFS	Current	Alternative					
				A	B[1]	C	D	E	PA
Current	E. Cascades		17						
	Klamath	1573	380						
	W. Cascades	2206	302						
	Coast	243	310						
	Total	**4022**	**1009**						
10 Years	E. Cascades			12	13	14	14	19	14
	Klamath			79	85	314	328	348	304
	W. Cascades			198	210	262	260	277	242
	Coast			190	208	272	290	290	270
	Total			**479**	**516**	**862**	**892**	**934**	**830**
50 years	E. Cascades	-		1	6	22	9	36	22
	Klamath	1690		55	129	297	315	483	270
	W. Cascades	1728		38	96	178	236	320	213
	Coast	207		58	119	154	304	321	288
	Total	**3625**		**152**	**350**	**651**	**864**	**1160**	**793**
100 Years	E. Cascades	-		1	7	39	25	42	28
	Klamath	1840		65	62	596	442	588	506
	W. Cascades	1763		50	119	454	286	402	296
	Coast	245		82	151	558	402	431	371
	Total	**3848**		**198**	**339**	**1647**	**1155**	**1463**	**1201**

[1] The NA alternative was not included in GIS, so a separate analysis was not conducted. NA is assumed to most closely resemble alternative B.

Appendix 4-19. A Spatially Explicit Life-History Simulator for the Northern Spotted Owl

Kevin McKelvey, *Wildlife Biologist, USDA Forest Service PSW*

June 16, 1992

Introduction

The probability of an organism surviving a specif ied time interval is the product of the probabilities of surviving a series of discrete risks distributed across that interval: the risks include predation, starvation, exposure to the elements, and disease. Similarly, the probability of an organism successfully reproducing is linked to the ability to find a mate, the risks to the offspring, and the metabolic constraints imposed on the adults. The fundamentals of both birth and death processes are therefore based on the environmental properties of the area in which the organism exists and to its proximity to potential mates. To survive in a heterogeneous environment, an organism preferentially inhabits habitat favorable to its survival and avoids barren or dangerous areas. The animal's movement and response to environmental heterogeneity is therefore evolved to exploit the use of available resources so as to maximize lifetime reproductive output.

Habitat dependencies for survival and reproduction are fundamental to population ecology, and yet they are seldom incorporated into population models. In traditional modeling, these relationships are largely ignored. Mating efficiency, survival to first breeding and the metabolic status of the parents are all, for example, encompassed by two parameters: the observed birth rates and prereproductive survival rates. Given just these parameter estimates all of the complexities associated with the interface between the organism and the environment are lost. If the habitat remains constant, this is an acceptable simplification. however, management activities and disturbance events alter the habitat in which the organism exists, then the interface between the organism and its environment must be modeled explicitly. In forestry, for instance, management consists primarily of vegetative manipulation resulting in habitat change. Forest management, from a wildlife standpoint, is a vegetation treatment experiment in which wildlife population levels are important dependent variables.

To project the impacts of land management activities, models must relate population demographics explicitly to the landscape in which the organism exists. Otherwise, there can be no assessment of the potential impact of a change in landscape pattern. In addition, if the pattern of manipulation leads to a fragmented system, then the spatial relationships between the various treatments must be explicit as well.

A spatially explicit model that directly links habitat variation to demographic variation is therefore essential to assess population viability. In addition, such a model allows the efficacy of various landscape patterns to be tested and provides a means to explore interactions between the distribution, amount and quality of habitat and population dynamics (Urban et al. 1988, Pulliam et al. unpublished) . In this type of model, habitat quality is defined in terms of demographic parameters. Habitat is 'suitable' for an organism if organisms that utilize that type of habitat either have high survival rates, high birth rates or both. In particular, suitable habitat can be defined as habitat in which the combination of birth and death rates allows for a stable or increasing population.

The northern spotted owl (*Strix occidentalis caurina*), is a habitat specialist that utilizes late-seral-stage forests (Thomas et al. 1990). The acreage in these timber types has declined rapidly since the late 1940's, due primarily to high levels of timber harvest (Thomas et al. 1990), and the pattern of harvest on the landscape has lead to a high degree of fragmentation in the remaining habitat. The spotted owl is a monogamous breeder, territorial, with large (>1000 ha) home ranges (Thomas et al. 1990, Appendix I), and obligate juvenile dispersal. Juvenile dispersal ability is limited; the longest published straight-line juvenile dispersal distance is 62 miles (100 km) (Thomas et al. 1990, Appendix P, Table PI) . Given obligate dispersal and uncertainties associated with mate f inding, it is likely that isolation and f ragmentation on the scale of the home range will have an impact on the ability of dispersing owls to colonize new territories and form breeding pairs.

The Model

A spatial model was created to simulate the impact of forest management on populations of the northern spotted owl. The basic premise of the model is that an

organism's survival and reproduction can be linked explicitly to its immediate habitat and that habitat's context within the larger landscape. That is, a population's rates of survival and fecundity will vary based on map configuration. In addition, the model allows for habitat areas that are unsuitable or marginally suitable for nesting. Lastly, the model assumes that each organism must search the landscape to find a mate.

The model is a single-organism simulator. Each organism is born, moves, attempts to find a mate and breed, and dies. This format allows the behavior of each individual to be simulated by following a series of probabilistic rules rather than through the abstraction of an equation set. The model is flexible, allowing for the analyses of individual characteristics as well as population dynamics. The average distance moved by individual birds before death or pairing, for example, can be output, and thus compared with data from banding or telemetry studies to determine if the simulated movement produces a path-length similar in magnitude to the observed behavior.

Model Details

Life History

The model partitions owls into classes based on age, sex, and breeding status. Because it is not possible to determine the age of adult ($\geq$ 2 years of age) owls in the field, a stage-structured modeling approach (Lefkovitch, 1965, Caswell 1989, Thomas et al. 1990: Appendix L) has been adopted. Both sexes are modeled, with birds partitioned into three stage classes: first year birds (juveniles), second year birds (sub-adults), and birds older than two years (adults). Two classes of paired birds are recognized, sub-adults and adults (Fig. 1). A sub-adult pair is defined as a pair containing at least one sub-adult bird. The age of f irst breeding is at 1 year, with one-year-old birds given a lower fecundity rate than older birds.

Males

Males are born and disperse f rom the nest site looking f or acceptable habitat to set up a territory. Determination of site suitability is a probabilistic process. As the site quality decreases, the probability that a male will decide that a site is suitable also decreases. The probability that a male becomes territorial on a site of a given quality is referred to here as the settling rate. If a suitable nest site is found, males stop moving and become territorial. Territorial males remain on this site until they die or the site becomes unsuitable for nesting. If the site becomes unsuitable, then the males become non-territorial and reinitiate search (Fig. 2).

Females

Females are born and disperse from the nest site looking for territorial males. When they find a territorial male, they obligately pair (Fig. 3). Once paired, females remain on the site until they die or the site becomes unsuitable for nesting.

Pairs

Pairs split up only when one member of the pair dies, or the site becomes unsuitable for nesting. If the female dies, the male remains territorial and stays on the site. If the male dies the female has no fidelity to the site and will initiate searching for a new mate (Fig. 4). If the site becomes unsuitable for nesting, both members search for a new site independently.

Movement from one age-class to another

As owls age, they move from juveniles to sub-adults and finally to adults. Survival probabilities are evaluated at each movement step within the annual interval and remain constant throughout the year. At the end of the year all birds still alive move to the next stage. Years start at the birth pulse.

The impact of shifting vegetation patterns on life-histories

In the model, changes in habitat quality can be made at the start of any annual cycle. If these changes result in the previously suitable occupied sites becoming less suitable, then the territorial status of the owls occupying those areas may be changed. Territorial males, whether paired or not, become nonterritorial at a rate of (i - the specified settling rate) for the land classification. If the males are paired and remain territorial, then the pair remains intact. If not, the pair breaks up into a non-territorial male and a female, and both birds begin independent search for new habitats. All owls will immediately be subject to the probabilities of survival and fecundity associated with the altered landscape.

Survival

Mortality is assumed to result from either starvation or predation, and these factors are assumed to be additive. Both factors are linked to site. Total risk is simply (l - survival probability). Survival probability is

evaluated based on habitat quality of the site currently occupied. Because risks are assumed to be constant over the course of the year, if the year is broken up into i time-steps, the risk per step f or an owl in stage j occupying habitat type k is defined as:

$$Rt = 1 - (1 - R_{jk})^{1/i}$$

where Rt is the Risk per time step and Rik is the yearly risk as defined for age class j and habitat class k. In pairs, the survival of each member is determined by their stage as well.

Movement

The map is divided into a f ixed array of grid cells, each cell representing one territory-sized unit. The grid is hexagonal to allow more realistic movement than is provided by a square grid (Pulliam et al. 1992, Lamberson and Voss, Personal communication). The rate of movement is dependent on the size of the grid cells and the number of time-steps per-year. Individual moves are restricted to adjacent cells. All of the mobile classes of owl (nonterritorial males and females) have the opportunity to move at each time-step. To ensure that certain birds or areas of the map are not given preferential access to open territories or mates, the order of movement is fully randomized at each time-step.

The model allows owls to search with 'intelligence'; that is, they may favor movement through good habitat and avoid bad habitat. Similarly, females move obligately to known territorial males and non-territorial males may be averse to crossing defended territories. This intelligent behavior is modeled by giving the owls absolute knowledge of the cell that they occupy and incomplete knowledge concerning the immediately adjacent cells. They have no knowledge concerning more distant habitat. This knowledge takes the form of a series of switches and weighing factors that condition the probability of movement (table 1).

The movement controls can be broken down into four types. The first is a simple switch. In this case, if the criteria are correct, behavior is obligate. The second is a probabilistic switch. In this case, switching is performed with a certain probability if the criteria are correct: the behavior is obligate but the knowledge is not absolute. The process of females finding mates in adjacent cells, for instance, is a probabilistic switch. The logic is to simulate events such as a female being attracted by the vocalizations of a neighboring, unmated male.

The third control type takes the f orm of weighing f actors. In this case, knowledge is assumed to be absolute, but the behavior is not obligate. Vegetation characteristics affect owl behavior by weighing the likelihood that an owl will move in a particular direction. Weighing factors work in the following manner. At each time step a dispersing owl can move into one of six adjacent cells or may remain in its current cell. The probability of movement into any cell is therefore initially 1/7. This initial probability is then multiplied by each of the weighing elements. The product of all the cell probabilities times all the weighing factors is then scaled to sum to 1.0, and a cumulative distribution is created. A uniform random deviate is generated and its position in the cumulative distribution determines which choice is taken (table 2, Fig. 6).

Lastly, the model can simulate a variety of behaviors at the map edges. Three boundary conditions can be specified: absorbing, reflecting and wrap-around.

Details of Movement Parameters

The following is a detailed description of the parameters listed in table 1.

1. Become territorial. This parameter specifies the probability that a male will choose a site having a specific habitat quality as an acceptable territory. If the male becomes territorial and is located by a female, pair formation is obligate. The model is very sensitive to this parameter because it effectively sets the carrying capacity of the landscape.

2. Aversion. A weighing parameter that determines the behavior of the owl when faced with a variety of potential habitat types in the adjacent cells. Higher quality sites therefore have a greater likelihood of being selected than lower quality sites.

3. Site fidelity. A weighing parameter that influences the owl's decision to remain in the existing cell rather than to moving into adjacent cells. This parameter is similar to aversion in intent, but aversion only has an influence if there is a choice. An owl completely surrounded by poor habitat will have no criteria by which to choose and the choice will be purely random. Setting a low site fidelity to poor habitat will, however, cause the bird to move through these areas more quickly.

4. Linear propensity. Sometimes called a straightening parameter, this weighing parameter works in the f ollowing manner: Each owl has a one-move memory; the direction that was taken in the last move will be multiplied times the directional

weighing parameter. A large value will, therefore, make the owl move in a straight line. It should be noted that if the owl's last move was to stay put, the directional parameter will tend to make it stay put. This tendency can be compensated for by shifting the values of the parameter controlling site fidelity.

5. Territorial aversion. It is assumed that non-territorial males will avoid existing territories. This weighing parameter sets the degree of aversion.

6. Female finds male.

   a. Current cell. A switch - she obligately pairs.

   b. Adjacent cell. This parameter sets the probability that the female will find a male that is territorial in an adjacent cell. It is a probabilistic switch. If the value = 0, she will never find him. If the value is 1 she will always find him.

7. Boundary condition. Boundaries are treated as consisting of cells having special properties. In the case of reflecting boundaries, an owl at the map edge will have totally unsuitable land in those directions that lead off the map. When choosing a direction to move, the bird will show total aversion to the boundary and will never enter it. This method ensures that an extra move is not necessary to explore the boundary. In the case of absorbing boundaries, birds that cross the boundary are considered to be dead. In this case, the boundary is defined in terms of the adjacent cells within the map. Wrap-around boundaries can be thought of as a proxy of an open system. A bird that exits one edge re-enters on the opposite side of the map. In this case the boundary is defined in terms of the habitats that the bird will enter on the opposite side of the map.

Choosing a time-step

In this model, the probability of moving to an adjacent cell is a function of the condition of the local landscape and the biological propensities of the organism. Because transitions can occur at each time step, the number of time-steps per-year expresses an implicit rate of movement. Choosing the number of time-steps is not a casual process. Increasing the number of timesteps increases the velocity of travel. Choosing 40 steps rather than 20, for example, will double the potential number of territories that an owl can search. The critical question of scale involves the maximum possible dispersal distance before settling or death. The maximum recorded juvenile dispersal is 62 miles (100 km) (Thomas et al. 1990). If each hexagonal cell is 1000 ha in size, the distance across the cell is 1.96 miles (3.15 km). This would suggest 32 time-steps (64 miles) as possible appropriate yearly search distance. The probability of moving 64 linear miles in 32 time steps is, however, rather unlikely. In fact, in a pure random search the probability of taking 32 steps in the same direction on a hexagonal grid is almost zero (9xlO-28). The linear propensity (see above) would need to be set so high as to overwhelm all other movement considerations. The best way to determine whether a time-step is appropriate is to run the model using the desired movement parameters and compare the mean distance to death and distance to pairing produced by the model simulations to empirical data (Thomas et al. 1990:305, Table Pl).

Fledging

Fledglings here refer to those that survive to disperse. It is assumed that there are good years and bad years for fledging. If it is a good year, then the pair produces fledglings according to a beta distribution ranging from zero to a specified maximum clutch size. There are therefore two levels at which variability can impact the number of fledglings. If the area of the beta distribution is concentrated close to the mean, then the population will pulse based on the frequency of good years. When a good year occurs, all of the pairs will produce about the mean number of fledglings. If the probability of a good year is set to 1.0, then variability in the number of fledglings will be on an individual nest basis and will be dependent on the shape of the beta distribution. The form of the beta distribution can potentially be unique for each land class and age class. Because this is a two-sex model, the sex ratio of fledglings is also adjustable.

Random number generation

Because all of the model dynamics are controlled by the generation of pseudo-random numbers, it is important to test the randomness of the generator. The random number generator utilized in the model has passed a series of standard tests (Appendix).

GIS interface

The model has a module that allows the user to generate maps for purposes of display and to analyze the effects of hypothetical landscape patterns on population dynamics. In addition, an automated link has been created between the model and vector-based Geographic Information Systems (GIS) to allow integration with actual vegetation maps. Using this

link, a hexagonal grid with size appropriate to the home range of the species being modeled is intersected with the map and the area of discrete vegetation types contained within each hexagonal grid-cell is analyzed to determine habitat quality. This allows for a rapid translation of vegetation data collected on a stand-level into habitat quality on scale of individual owl home ranges. Maps generated through the GIS interface can be modified at the home-range level using the mapping facilities included in the model. Maps created by the model can also be transformed into vector-based GIS maps. This ability to move information freely between the GIS and the model allows a dynamic interaction between land management decisions and the potential impact of those decisions on owl populations. A manager can manipulate vegetation at the stand level within a GIS and evaluate the impact of those changes on owl populations. Model output such as mean pair occupancy for each cell (output as a map), based on a large number of simulations, can then be overlaid over the stand-level map to determine which stands correlate with areas displaying either high or low occupancy rates.

Results

The model was used to project population trends from five hypothetical landscapes with an identical number of suitable sites (Fig. 6-10). Other than habitat configuration, there were no dif f erences in the initial values of any model parameters. The map boundaries were wrap-around so that the exact location of the habitat within the map frame was unimportant. The demographic parameters (Table 3) were set to yield a finite growth rate of 1.0 and were not modified by habitat quality. In these simulations only two habitat qualities were simulated: habitat suitable and habitat unsuitable for nesting. The movement parameters deviated only slightly from a random walk: birds were twice as likely to choose suitable habitat, males treated occupied habitats in a manner identical to unsuitable habitat, and birds were twice as likely to move in the same direction as to choose a different direction. These deviations from random behavior were chosen so as to improve search efficiencies on all maps. Extreme aversion to poor habitat will, for instance, be beneficial in highly grouped habitats since it will effectively confine the search to those areas that are acceptable for nesting. It is, however, detrimental in very dispersed systems since, in these systems, juveniles must cross poor habitat in order to explore the landscape. Weak selectivity will be beneficial in both systems. Strong habitat selectivity in juvenile dispersal is also not supported by dispersal studies (Gutierrez et al. 1985, Miller 1989) the literature. Similarly, a small increase in the linear propensity has the primary impact of preventing useless searching caused by doubling-back.

<u>The effects of clustering</u>

The model results support previous model results (Doak 1989, Thomas et al. 1990, Lamberson and Noon, unpublished) in showing that a clustered structure is both more efficient in terms of mean population level and more stable in terms of lowered extinction probabilities than is a random structure. A spatial analysis of mean pair occupancy demonstrated that the small degree of stability shown by the random system occurred in the upper left-hand portion of the map where the density of suitable territories, through random chance, was highest.

The effects of shape

The shape of reserve areas also has an important impact on their stability properties. A cluster with a low edge-to-area ratio (Fig. 8) is more stable than continuous clusters with identical area but with varying degrees of irregularity. (Fig. 9-10) The population trend for the large, highly irregular cluster (Fig. 10) is similar to the system of three small clusters (Fig. 7).

Source-sink relationships

The previous results demonstrate the impact of reserve configuration when each landscape cell is either suitable or unsuitable f or breeding and the survival rates are constant f or all sites. In actual landscapes, the habitat lies along a quality gradient, from ideal to totally unsuitable. Within this gradient, there will be source locations that, on average, produce an excess of individuals and sink locations into which some of these juveniles will settle. The choice of settling point may well be globally sub-optimal (Pulliam 1991). An organism has no means to ascertain the availability of habitat except through experience and exploration. In this model, this process is simulated by varying the settling parameter. This parameter, which only applies to males (see Fig. 2), defines the probability that a bird will settle and become territorial in the site that it currently occupies. To test the effects of a reserve design embedded in a landscape that is marginally suitable to one that exists in a completely unsuitable landscape, a small reserve system was created and simulations were performed using two rule sets (Tables 3,4). All parameters were the same except for the settling rate for areas exterior to the reserve.

The presence of marginal habitat adjacent to reserves can have a negative impact on the stability of the

reserve system (Fig. 11,12). Even though the mean population size is larger in the source-sink system, the mean occupancy of the reserve clusters is lower and the variability of the system increases with time, leading to increased risks of extinction.

Discussion

An analysis of model behavior

A great deal of the behavior of any model is dictated by its structure, and this model is no exception. It is, in essence the sequel to a series of models originating with Lande's non-spatial deterministic model (Lande 1987, 1988), followed by dynamic versions in Thomas et al. (1990) and expanded in Lamberson et al. (in press) and Lamberson and Noon (unpublished ms).

This model differs from traditional stage structured population models (Begon and Mortimer, 1981; Getz and Haight, 1989) in many ways including the modeling of both reproductive and nonreproductive life history stages. In comparing a simple stage structured model with the landscape model (compare Figs. 1 and 13) pair survival differs because, in the spatial model, both members need to survive in order for the pair to survive. The probability of a pair breaking up is theref ore one minus the square of the adult or sub-adult survival rate (Fig. 1).

Flow rates between the reproductive and non-reproductive stages depend on survival rates, but movement from the nonreproductive states into the reproductive classes is mitigated by the probability of pair formation (P(p)) (Fig. 1). As P(p) -> 0, entry into the reproductive population also -> 0, and the population will decline. As P(p) -> 1, the non-reproductive vector empties and the model collapses into the reproductive classes. P(p) is the parameter through which spatial relationships impact the life history of the organism.

P(p) is closely related to the probability of finding a suitable site. For males, a suitable site is defined by the cell's quality and occupancy status. For females, suitability is defined by the presence of a territorial male. Even though the criteria are different, the search process is similar.

In an unconstrained random walk, and allowing a fixed number of cells to be searched, the probability of searching a cell declines rapidly with distance from the point of origin (Fig. 14). If the total number of cells searched is increased, the probability of searching a cell increases slowly and asymptotically (Fig. 15). For this reason, distance dominates search probabilities (Fig. 15,16). The model is, therefore, reasonably insensitive to changes in search velocity and extremely sensitive to the spatial positions of the reproductive pairs in the landscape.

In the model, birds search with a fixed survival probability, rather than searching a fixed number of times as has been the case in other models (Lande 1987, Thomas et al. 1990, Lamberson et al. in press, Lamberson and Noon unpublished). This difference, however, is unimportant to the model dynamics: equivalent search functions can be generated using either approach (Fig. 17).

P(p) will decline if the population is high, because unoccupied sites will be scarce and will tend to lie in areas that are distant from large groups of reproductive pairs. P(p) will also decline if the population levels are low, because searching females will have difficulty finding territorial males. P(p) will decline as the population becomes more diffuse. As a result, any actions that cause the mean distance between reproductive pairs to increase will therefore always impact the finite rate of increase of the population.

Model behavior at high population levels is qualitatively similar to a logistic model. At low densities, however, the models diverge. The logistic model assumes that population response will be most robust (the ratio of birth/death will be largest) when the population is depressed. If search is explicitly modeled, there are positive benefits associated with density. When the density drops in the context of abundant habitat, territorial males may go unpaired due to the low density of females: females will not locate males and form pairs before they die. If, in addition, low population densities are associated with long distances between potential territories, as is the case when habitat is fragmented, then the ability of the males to find territories will be reduced as well. This model, and all of the models following Lande (1987) will therefore have threshold points defined by population density and degree of habitat fragmentation at which the population will collapse. Population instability has sometimes been introduced into traditional models by incorporating an 'Allee effect' (Allee 1931; Noy-Meir 1975), but the correct functional form and strength of this effect is not clear. In this model, the 'Allee eff6ctl occurs naturally as a direct result of search.

Fecundity

The population birth rate B is also affected by costs associated with search:

$$B = b * P(m) \tag{2}$$

$$P(m) + f(s,e,P(p)) \tag{3}$$

where

B is the population birth rate,
b is the measured birth rate for paired females,
P(m) is the probability that a female has a mate, and s is the adult survival rate.

P(m), represents the balance between pair break-up and pair formation. Pair break-up is a function of the adult survival rate which is based on site quality, and is assumed to be density independent (the presence or absence of adults on the same site or in adjacent sites has no impact on the parameter value) . The rate of pair formation is controlled by P(p).

If b is constant, then B will simply follow P(p). It is this decline in B that causes diffuse populations to collapse (Fig. 6) even when there are no decreases in survival probability associated with search.

Questions of scale

Fragmentation has the impact of altering phenomenon which are dependent on contagion. Contagion can have effects that are either positive or negative. The success of females searching for territorial males is positively af f ected by contagion. The negative consequences associated with disease or the spread of fire are also dependent on contagion. Fragmentation is not, therefore, negative per-se. Its consequences, good or bad, are solely dependent on the extent to which it affects various contagion-related phenomena. Contagion phenomena will always be scale dependent - and these dependencies will be rooted in the biological and physical properties of the phenomenon. Fire, for instance, can be effectively stopped by a rather narrow fire break. This fire break may have absolutely no impact on the dispersal efficiency of a large raptor, but may represent an absolute barrier to a salamander. Similarly, a disease that depends on direct transmittal could easily be controlled by producing a f ragmentation pattern that separated the members of the species in question. If, however, the disease were vectored through a prey item, then f ragmenting the system would only be an ef f ective method of disease control if it reduced the encounter rate between the predator and its infected prey.

When modeling spatial phenomenon, it is necessary to choose an explicit spatial scale at which to model. Smaller scales will need to be implicitly modeled through indices - and these indices may, themselves be scale dependent. In this model, each home-range-sized polygon is given a quality index, and this index is in turn linked to fitness values. For modeling the spotted owl, the explicit scaling is very large (1000 ha) - based on the average size of individual owl home ranges. The fragmentation of vegetation on the landscape, however, is on the order the size of timber sale units (about 10 ha). If, for example, the quality index for a home range were based on the acreage of suitable habitat within the home range, all spatial patterning below the size of the home range would be ignored by the mode 1. Any home range with 50% owl habitat will be modeled as being of equivalent quality (equal values for mortality, aversion, etc.) regardless of the pattern of the remaining habitat within the home range. If spatial patterns within the home range are thought to be important, then they must be incorporated into the home range quality index through the use of spatial statistics such as average patch size or fractal dimension. Because fragmentation is only explicitly modeled at the broadest scale, fragmentation at lower scales may have impacts both positive and negative that are not represented by model behavior.

Territories as islands

Territories can be thought of as small islands, each having a maximum of one reproducing pair. Like islands, they have spatial dimension - they occupy a certain area of the map. And, like islands, when they experience local extinction (in this case one or both members of the pair either dies or emigrates), they must be recolonized through immigration from owls outside the territory or by an existing,, non-territorial Ifloaterl population within the territory.

The concept of territories as individual islands is key to the dynamics of clusters in the model. Larger reserves can be thought of as an archipelago in which all of the islands are very close to one another. Fragmenting the landscape has the effect of moving the islands further apart.

The loss of a reproducing pair is, in effect, a local extinction. The rate of recolonization of an individual territory will be dependent on the spatial arrangement of the habitats and the fecundity of the reproducing pairs; that is, how many individuals are looking for territories or mates and the likelihood they will find the site in question.

Typical yearly adult survival for spotted owl adults ranges between 0.81-0.92 (Thomas et al. 1990: 230-231). The pair survival rate (both members survive) will therefore range from 0.72 to 0.84. When the probability of search by dispersing juveniles falls below the pair survival rate, juvenile dispersal mechanisms will not be sufficient to maintain the population of pairs at their habitatbased carrying capacity. The system will

become dependent on recolonization by non-territorial adult lfloaters, that are already on-site. As pairs are lost due to local extinction, this will increase the distance between reproductive pairs, further increasing the disparity between extinction and colonization rates. In the absence of a balance between the rates of pair loss and reestablishment, the population will unavoidably tumble towards extinction.

The role of clusters

From a modeling standpoint, a system of clusters is more stable than a diffuse system because the clusters produce regions where search efficiency is maximized. In a cluster of suitable territories, a population can recover from low levels because P(p) will remain high. That is, because all of the remaining members of the population remain close, the impacts on P(p) are minimized and the model behaves like a traditional population model, exhibiting positive growth rates when occupancy is reduced. Dispersing males have a high probability of finding habitats immediately adjacent to existing pairs. Dispersing females will more easily find the territorial males because of their adjacency. The key to successful clusters is clearly to make the clusters large enough to avoid high levels of extinction at the cluster level. In practice this means that each cluster's carrying capacity should be large enough that normal population declines driven by environmental and demographic stochasticity do not drive the population down to levels at which random extinction is likely. Looking only at demographic stochasticity, this would suggest a minimum cluster population size of approximately 20 breeding pairs (Richter-Dyn and Goel 1972).

The effect of shape

The negative impacts caused by cluster irregularity are also due to habitat search. A circular cluster of suitable habitat minimizes the distance between clusters. All other geometric forms will have reduced P(p) when compared with the a circular cluster. The impact of cluster irregularity are, in fact, probably more pronounced than is indicated by figures 8-10. In these simulations, the risks associated with crossing poor quality habitat were identical to those encountered in suitable habitat. If greater risks were encountered in the poor habitat, the effects of irregular,cluster shape of would be accentuated.

Source-sink dynamics

The increase in variance that is observed in systems containing marginal habitat for nesting (Fig. 12) is due primarily to the increased variance in adult survival rates. If nesting is restricted to the clusters, the population will equilibrate with a relatively constant proportion of the adult population within the clusters and dispersing through the matrix. Changes in the population vital rates will, therefore, be bounded by the levels of environmental and demographic stochasticity, and population variability will remain reasonably constant over time.

When breeding occurs exterior to the clusters, the population becomes more dynamic. Both the vital rates and the spatial configuration of the population will be dependent on the proportion of the population that exists exterior to the reserve structure. If a large number of the breeding pairs lie exterior to the reserve, not only will the overall survival rates decline, but the system will also become diffuse, lowering P(p). The bounds on the population growth rates will therefore be set by both the proportion of the breeding population found exterior to the reserve and the levels of environmental and demographic stochasticity. Because the model runs are begun with all of the birds within the reserve structure, variability increases over time (Fig. 12).

The decline in mean occupancy levels in the source-sink system is due to decreased interaction between clusters. Dispersing juveniles that settle exterior to the reserve would, if this option were not available, continue searching and some of them would become pairs within the clusters. This outcome suggests that a reserve design may be more stable if the boundaries between the reserve and the surrounding landscape are very distinct. Maintenance of sink areas exterior to the reserve system may lead to sub-optimal choices on the part of dispersing juveniles.

Summary

A model containing explicit links to landscape vegetation patterns was created. Its results are consistent with previous models based on search efficiency (Lande 1987, 1988, Doak 1989, Thomas et al. 1990). An analysis of the model structure demonstrates that this model form will favor clumped reserve structures over diffuse structures due to the inherent geometric properties of the search function. The model results and subsequent analysis indicate that land management policies that increase fragmentation are extremely detrimental to territorial populations because the uncertainties of successful search cause the population dynamics in reduced populations to experience reduced rates of territory recolonization. Low population levels in fragmented systems will not, therefore, exhibit the strong upward population pressure inherent in traditional density-dependent models.

Recovery will be slow and difficult and, at a specific level of fragmentation, impossible.

Negative impacts associated with fragmentation can be mitigated by clustering reserves. Clusters will display greater search efficiencies and will be more stable than a random diffuse system with equal acreage in suitable habitat.

In addition to supporting these general conclusions, this model extends the capabilities of previous models through its ability to directly model the irregular and patchy habitat configurations found in real landscapes. It also allows f or a gradient of habitat quality and ties risk and movement rules directly to that gradient. These properties allow owl demographics to be based directly on map information held in GIS systems, and allows the modeling of populations in spatially dynamic landscapes.

Model Implementation: The BLM in Oregon

Parameterizing the Model:

All of the landscapes used up to this point have been hypothetical. In order to link the model to actual landscapes, links must be made between the configuration of the landscape and its quality as owl habitat. Because the this linkage is performed through the use of a GIS database, the landscape attributes must be chosen from those available within the GIS. In order to facilitate this process, Jon Bart, chairman of the Northern Spotted owl Recovery Team, looked to the available data to determine those habitat attributes that were linked to specific demographic information. The attribute that best correlated with survival, fecundity, and nest density of owls was the amount of mature forest within a region of the map surrounding the owl nest-site. For modeling purposes we translated this into the proportion of mature forest within a home-range-sized area, a hexagonal area 1000 ha in size.

Dr. Bart drew together the available data and constructed functions for survival and fecundity and the probability of nesting based on the amount of mature forest in a home-range-sized area. These relationships were discussed at a series of meetings with a group of biologists employed by the Forest Service, Bureau of Land Management, and private industry.

our purpose was to utilize these parameters, in conjunction with projected management plans, to look at future forest conditions and to evaluate the efficacy of those plans in terms of the maintenance of owl populations. our primary purpose was comparative: we wished to evaluate and ordinally rank the management plans, not to attempt to predict the number of owls within the landscape in 100 years. There are enormous uncertainties concerning the reliability of the habitat relationships, the recovery time f or stands that are cut, and patterns of land utilization on those lands not controlled by the *BIM*. The model results should therefore be interpreted conditionally: given that the tree growth rates, habitat relationships and owl behavior patterns occur exactly as specif ied, the plans produce the following number of owls in the following locations 100 years into the future.

Because of these uncertainties, we ran the model for each management alternative using 3 sets of parameters. Each was based on Dr. Bart's original parameters (Table 5, Fig. 18), but the parameters were shifted: In the second set, the parameters associated with >60% mature forest also were true for cells with 40-60%. In the third set, these parameters were true for stands having >30% suitable habitat. All other parameters were similarly shifted (Fig. 19). This shifting, in effect, changed the evaluation of the landscape, but did not change the behavior of the owls within habitat of a specific quality. Viewing the landscape as a system of sources and sinks, in Dr. Bart's rule set only homerange areas with > 60% mature forest are considered sources. In the second rule set Home range areas with >40% mature forest are sources, and in the third set home-range areas with >30% mature forest are sources. Dr. Bart's original rule set will therefore produce the lowest number of owls. The other two model runs are less pessimistic.

Acknowledgements

This modeling was supported by the USDA Forest Service, Redwood Sciences Laboratory, Arcata, California and was carried out as part of a post-doctoral appointment. Special thanks are given to Roland Lamberson, Humboldt State University, for many hours of consultation concerning model construction, Curtis Voss, Redwood Sciences Laboratory, for coding the unit controlling map appearance (CLASS.EXE) and Barry Noon, Redwood Sciences Laboratory, who has been the driving force behind both this modeling and previous models presented in Thomas et al. (1990). Without the help and support of these individuals, and many others as well, this work could not have occurred.

Literature Cited

Allee, W.C. 1931. Animal aggregations A study in general sociology. University of Chicago Press, Chicago, IL.

Begon, M. and M. Mortimer. 1981. Population Ecology. A unified study of animals and plants. Blackwell Scientific Publications, Boston.

Doak, D. 1989. Spotted owls and old growth logging in the Pacific Northwest. Conservation Biology, 3: 389-396.

Franklin, A. B., J. A. Blakesley, and R. J. Gutierrez. 1990. Population ecology of the northern spotted owl (*Strix occidentalis caurina*) in northern California: Preliminary results, 1989. California Fish and Game, Technical report 1990-9. Sacramento California, USA.

Getz, W.M. and R. G. Haight 1989. Population harvesting: Demographic models of fish, forest, and animal resources. Princeton University Press, Princeton N.J.

Gutierrez, R. J., A. B. Franklin, W. Lehaye, V. J. Meretsky, and J. P. Ward. 1985. Juvenile spotted owl dispersal in northwestern California: preliminary results. Pages 60-65 in R. J. Gutierrez and A. B. Carey editors. Ecology and management of the spotted owl in the Pacific Northwest. USDA - Forest Service Gen. Tech. Rep. PNW-185.

Lamberson, R. H., R. McKelvey, B. R. Noon, and C. Voss. 1991. The effects of varying dispersal capabilities on the population dynamics of the northern spotted owl. Conservation Biology, In press.

Lamberson R. H. and B. R. Noon. Unpublished. The territory cluster model: a spatial model for the northern spotted owl.

Lamberson, R.H. and C. Voss. Humboldt State University, Personal communication.

Lande, R. 1987. Extinction thresholds in demographic models of territorial populations. American Naturalist, 130: 624-635.

Lande, R. 1988. Demographic models of the northern spotted owl (*Strix occidentalis caurina*). Oceologia, 75: 601-607.

Lefkovitch, L. P. 1965. The study of population growth in organisms grouped by stages. Biometrics 21:1-18.

Miller. G. S. 1989. Dispersal of juvenile northern spotted owls in western Oregon. M. S. Thesis. Oregon State University, Corvallis, Oregon.

Noy-Meir, I. 1975. Stability of grazing systems: an application of predator-prey graphs. Journal of Ecology, 63: 459-483.

Pulliam, H. R. and B. J. Danielson. 1991. Sources, sinks and habitat selection: A landscape perspective on population dynamics. American Naturalist, In press.

Pulliam, H. R., J. B. Dunning, Jr., and J. Liu. 1991. Population dynamics in complex landscapes: a case study. Ecological Applications 2: 165-177.

Richter-Dyn, N. and *N. S.* Goel. 1972. On the extinction of a colonizing species. Theoretical Population Biology, 3:406-433.

Thomas, J.W, E.D. Forsman, J. B. Lint, B. R. Noon, and J. Verner.1990. A conservation strategy for the northern spotted owl. Report to the Interagency Scientific Committee to address the conservation of the northern spotted owl. Portland. OR.

Urban, D. L., H. H. Shugart Jr., D. L. DeAngelis, and R. V. O'Neill. 1988. Forest bird demography in a landscape mosaic. Oak Ridge National Laboratory, Environmental Sciences Division, Publication No. 2853.

Appendix

1. Moments. The first, second and third moments for a uniform random distribution should be 1/2, 1/3, and 1/4 respectively. Typical output for n = 1,000,000 are 0.5002, 0.3335, 0.2501 respectively.

2. Uniformity. In this test random numbers are generated and cast into a series of bins, based on their value. This test was run with 100 bins and a Chi-Square test was performed against the assumption that all bins would be equal in value. Typical values for n = 1,000,000 are < 1.0; The 0.05 critical value is approximately 120.

3. Pairs. This test looks at f irst order sequential correlation. Sequential pairs of random numbers are produced and binned based on their value. Ideally, all pairs should be produced with equal frequency. In this case the pairs were binned into a 10xlO matrix. A ChiSquare test was performed against the assumption that all matrix elements are equal in value. Typical values for n = 1,000,000 were < 2.0. Again, the 0.05 critical value is approximately 120.

4. Runs. This test looks at the overall degree of sequential correlation between random numbers generated. In this test, random numbers between 0 and 1 are generated and are rounded to 0 or 1 based on their value. As these numbers are produced they are grouped into 'runs'. 00010, for instance would have a run of 3 and two runs of 1. The run lengths are collected and, after a large number of random numbers has been produced the question is asked: is the population of runs generated significantly different than would be expected based on the binomial distribution. Here again, a ChiSquare test of f it was used to test for runs <= 30 elements in length. Typical values f or n = 1, 000, 000 ranged from 15-20. The 0.05 critical value is 41.3.

5. Period. All random number generators produce pseudorandom numbers in a deterministic cycle of finite length. The period of a random number generator refers to the length of the cycle. To test for the period, the random number generator is 'seeded' with a value and then is looped to produce random deviates until the 'seed' value is reproduced. The maximum period for a generator is, therefore, determined by the number of bits set aside to hold the seed, but may be less if the generator is improperly constructed. For the generator used in the model, the number of bits = 32, and the observed period is 2 32 = 4.3 billion. other tests can be run, but based on these results, there is no reason to assume that any non-random characteristics of the random number generator will **have** a significant effect on the model performance.

Table 1. A summary of factors that can affect an individual's movement in the model.

Factor	Based on	Sex	Form
Become Territorial	Habitat Quality/Occupancy	M	Probabilistic Switch
Aversion	Habitat Quality	M/F	Weighting
Site Fidelity	Habitat Quality	M/F	Weighting
Linear Propensity	Behavior	M/F	Weighting
Territorial Aversion	Occupancy	M	Weighting
Female Finds Male (Current Cell)	Occupancy	F	Absolute Switch
Female Finds Male (Adjacent Cell)	Occupancy	F	Probabilistic Switch
Global Boundary	—	M/F	—

Table 2. An example of the process used to determine movement in a heterogeneous landscape. If 0.448 were generated randomly, then direction 4 would be chosen. Direction 3 is never chosen.

Direction	The initial vector	Weighing factor	Scaled vector	Cumulative Probability
1	0.143	0.900	0.143	0.143
2	0.143	0.600	0.095	0.238
3	0.143	0.000	0.000	0.238
4	0.143	1.000	0.159	0.397
5	0.143	1.000	0.159	0.556
6	0.143	1.900	0.302	0.857
7	0.143	0.900	0.129	1.000

Table 3. List of the parameter values used for the simulations. Parameters were chosen to produce as optimistic an estimate of owl survival as could be supported by these data. Parameters only varied with site quality where explicitly stated.

Parameter	Value	Source
Juvenile survival	0.29	Franklin et al. 1990
Sub-adult survival	0.935	Thomas et al. iggo
Adult Survival	0.935	Thomas et al. 1990
Birth rate	0.335	Franklin et al. 1990
Aversion	1.0, 0.5[1]	
Boundary	Wrap-around	
Linear propensity	2.0	
Site fidelity	0.5	
Territorial aversion	0.5	
Female finds male	0.5	
Time-steps	40	
Runs	30	

[1]Only two habitat types were placed in the map, one representing the best habitat and the other representing the worst. This split corresponds to suitable/ unsuitable designations found in past models.

Table 4. List of the parameter values used for the cells exterior to the habitat reserve (Fig. 11, 12) . Parameters within the reserve, as well as general parameters that pertain to all cells are presented in Table 3. Parameters are those calculated for measured a demographic study, Roseburg, Oregon.

Parameter	Value	Source
Juvenile survival	0.219	Thomas et al. 1990
Sub-adult survival	0.588	Thomas et al. 1990
Adult Survival	0.812	Thomas et al. 1990
Birth rate	0.310	Thomas et al. 1990

Table 5. Rule set used for simulation of BLM management alternatives. Values for sub-adult and adult survival, and probabilities of pair formation are based on values derived by Dr. John Bart.

	Land Classification (percent)				
	<20	20-30	30-40	40-60	>60
Survival					
Juvenile	0.20	0.29	0.29	0.29	0.29
Sub-adult	0.38	0.38	0.41	0.45	0.50
Adult	0.75	0.76	0.82	9.90	9.96
Fecundity					
Adult	0.00	0.34	0.34	0.34	0.34
Movement					
Nesting prob.	0.13	0.40	0.55	0.83	1.00
Aversion	0.30	0.50	0.70	0.90	1.00
λ					
Non-breeding	0.75	0.76	0.82	0.90	0.96
Breeding	0.75	0.80	0.87	0.94	1.01

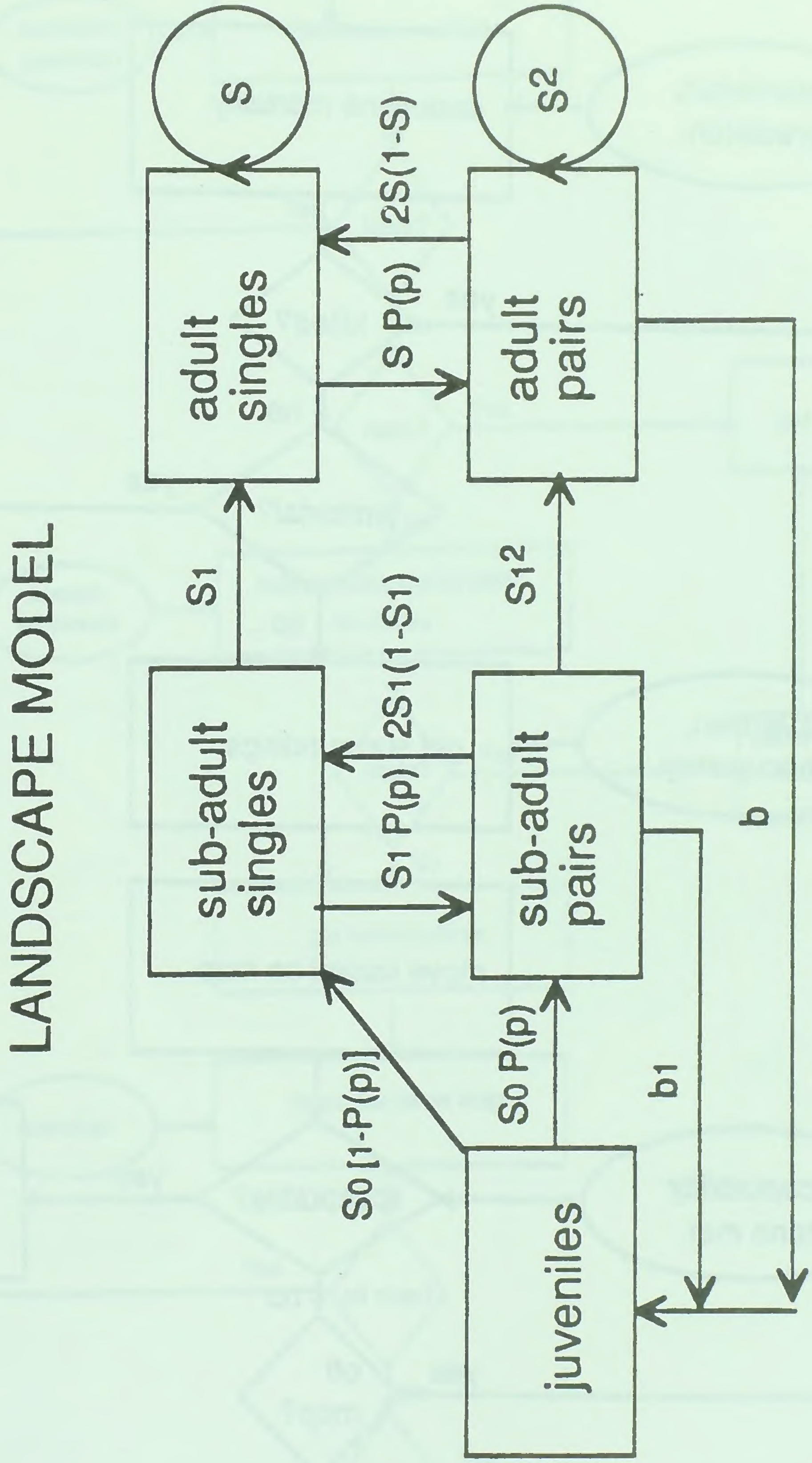


Figure 1. *Flow diagram of the life history structure used in the landscape model. P(p) is the probability of pairing.*

MALE MOVEMENT

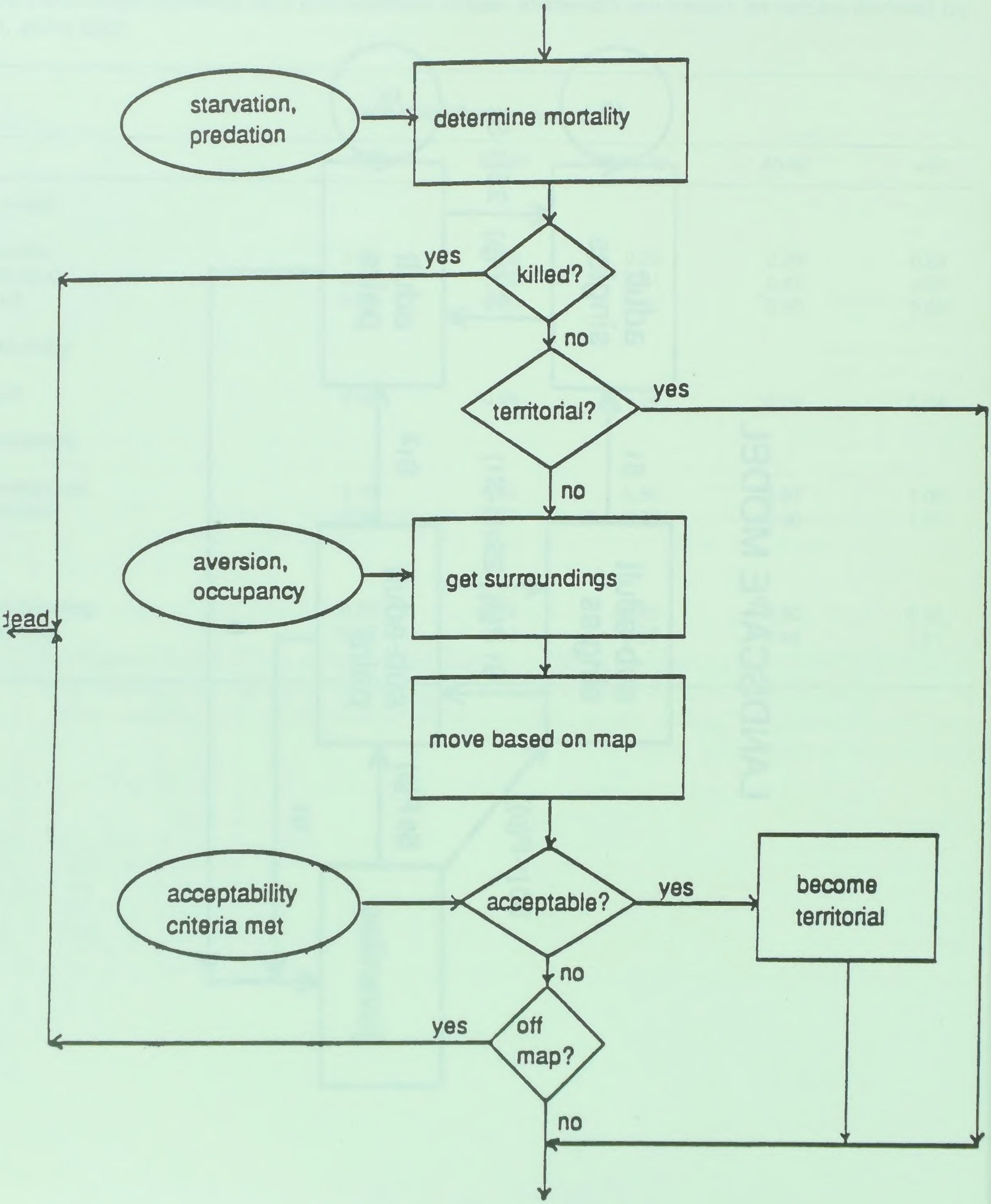


Figure 2. Flow diagram representing the process f or determining male behavior at each time step in the model.

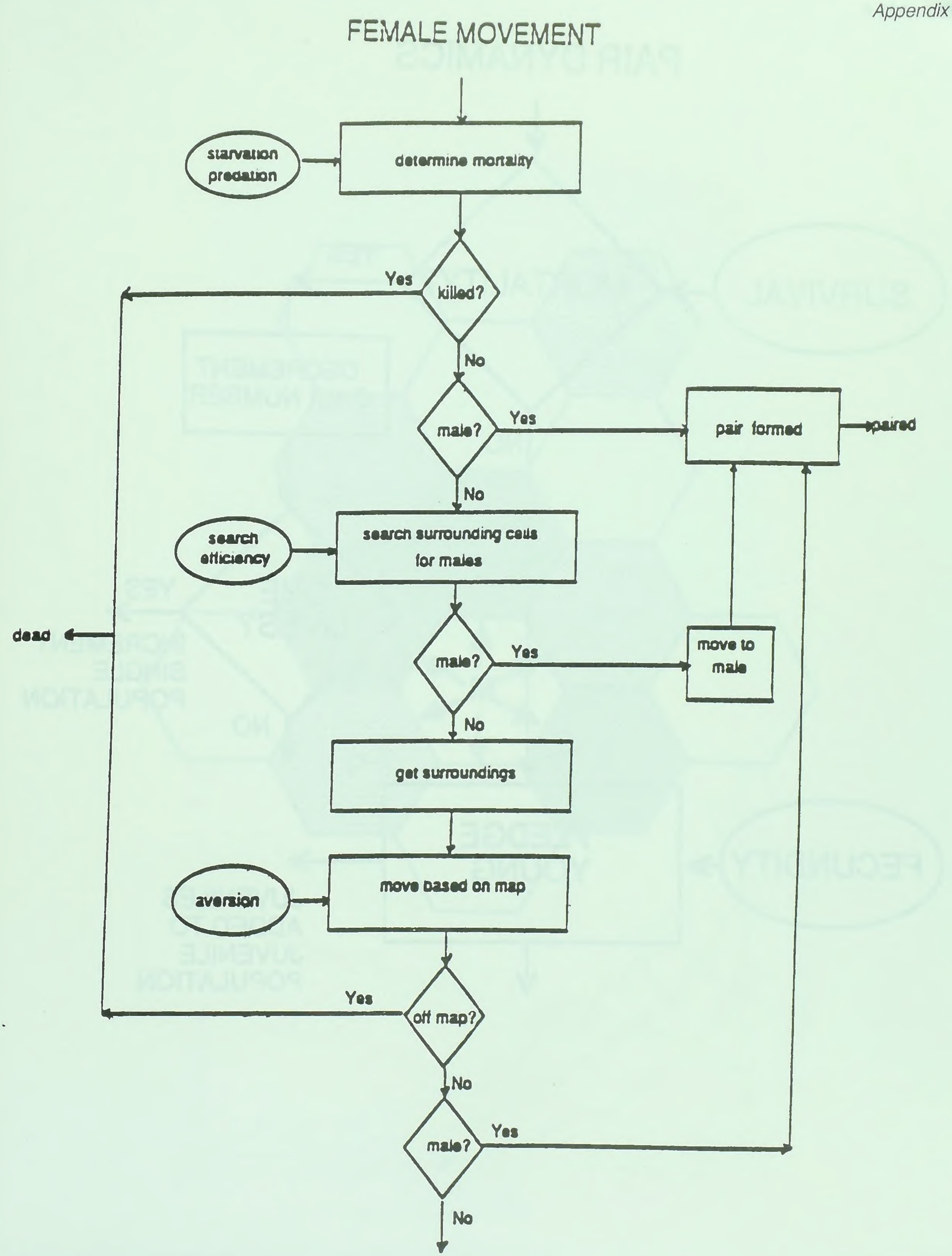


Figure 3. Flow diagram representing the process f or determining female behavior at each time step in the model.

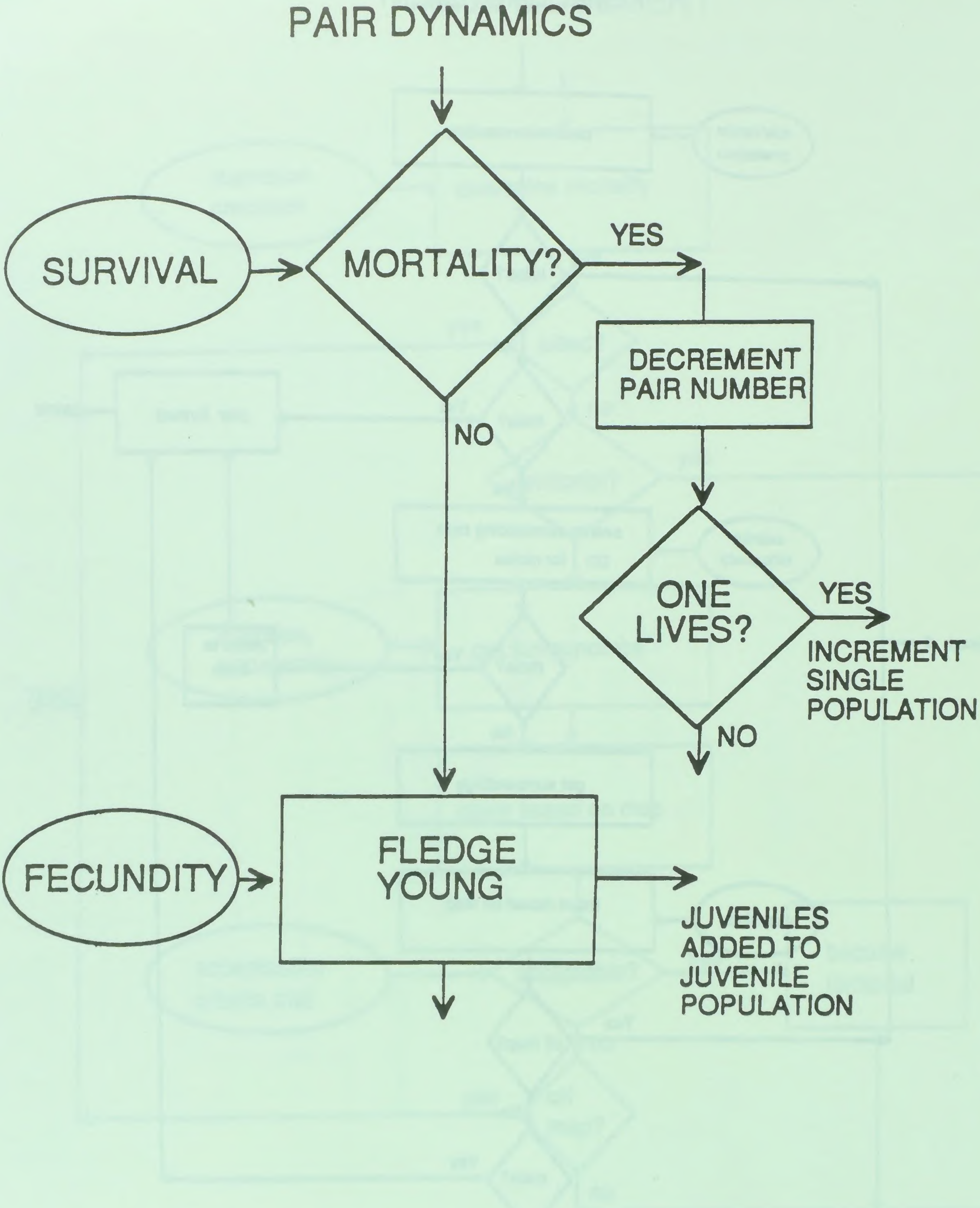


Figure 4. Flow diagram representing yearly pair dynamics. Pairs only remain reproductive if both members survive.

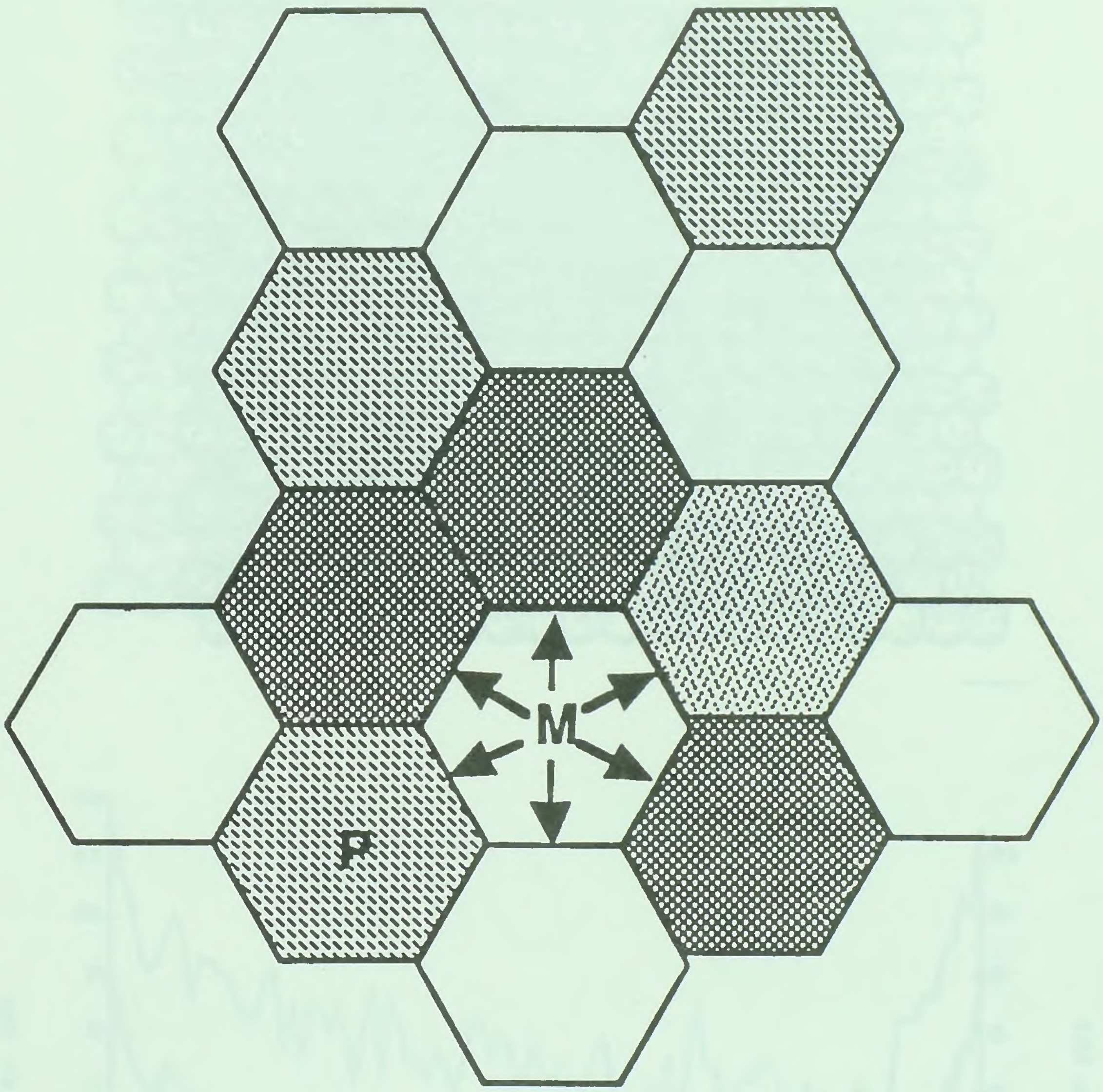


Figure 5. *The arrows represent the potential choices for a male in a heterogeneous landscape. The move will be based on a probability vector conditioned by the different qualities of the choices.*

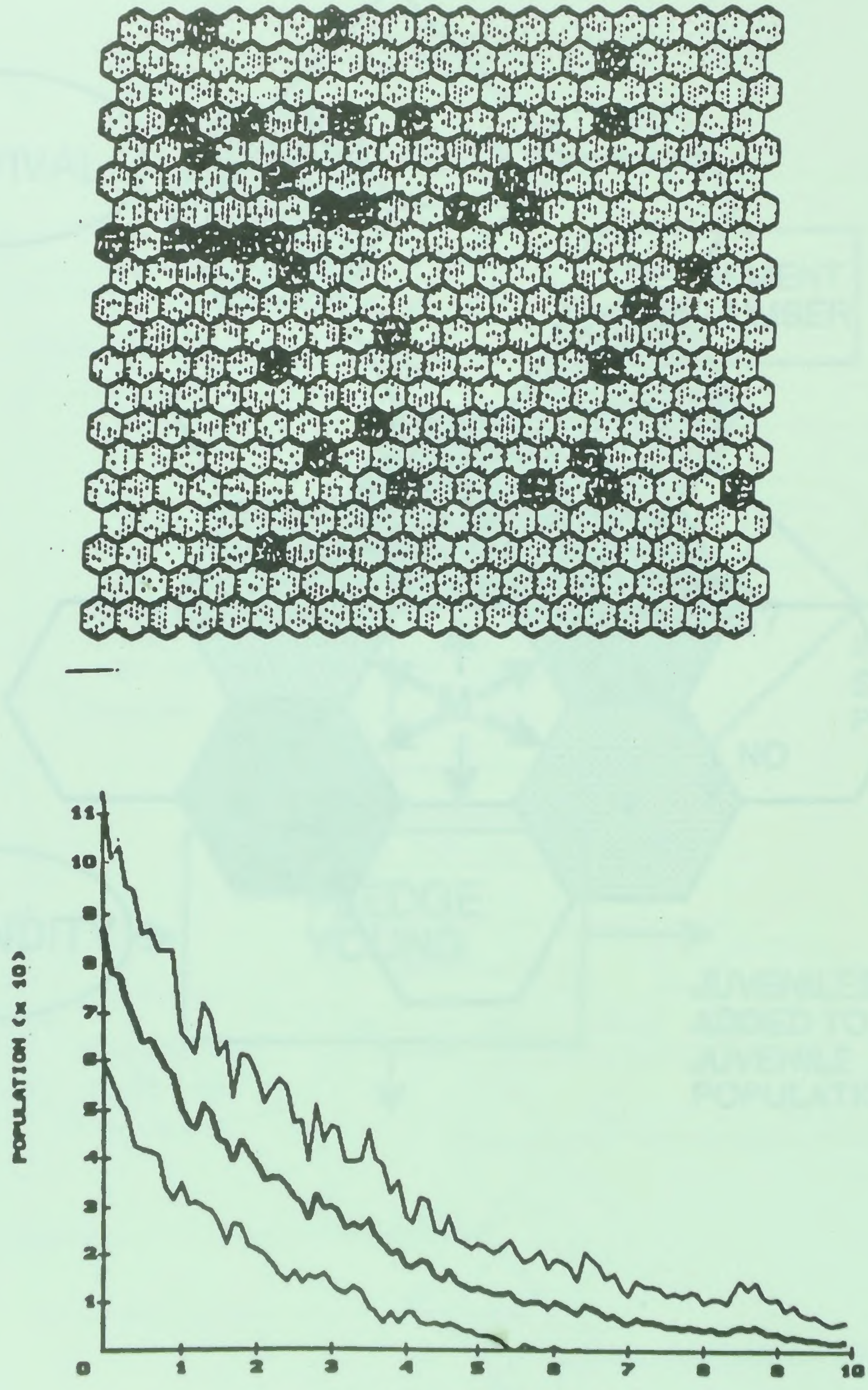


Figure 6. *Model simulation showing a simulated landscape with suitable habitat randomly scattered. The results are based on 30 simulations. The heavy line represents the mean population, the thin lines are one standard deviation from the mean.*

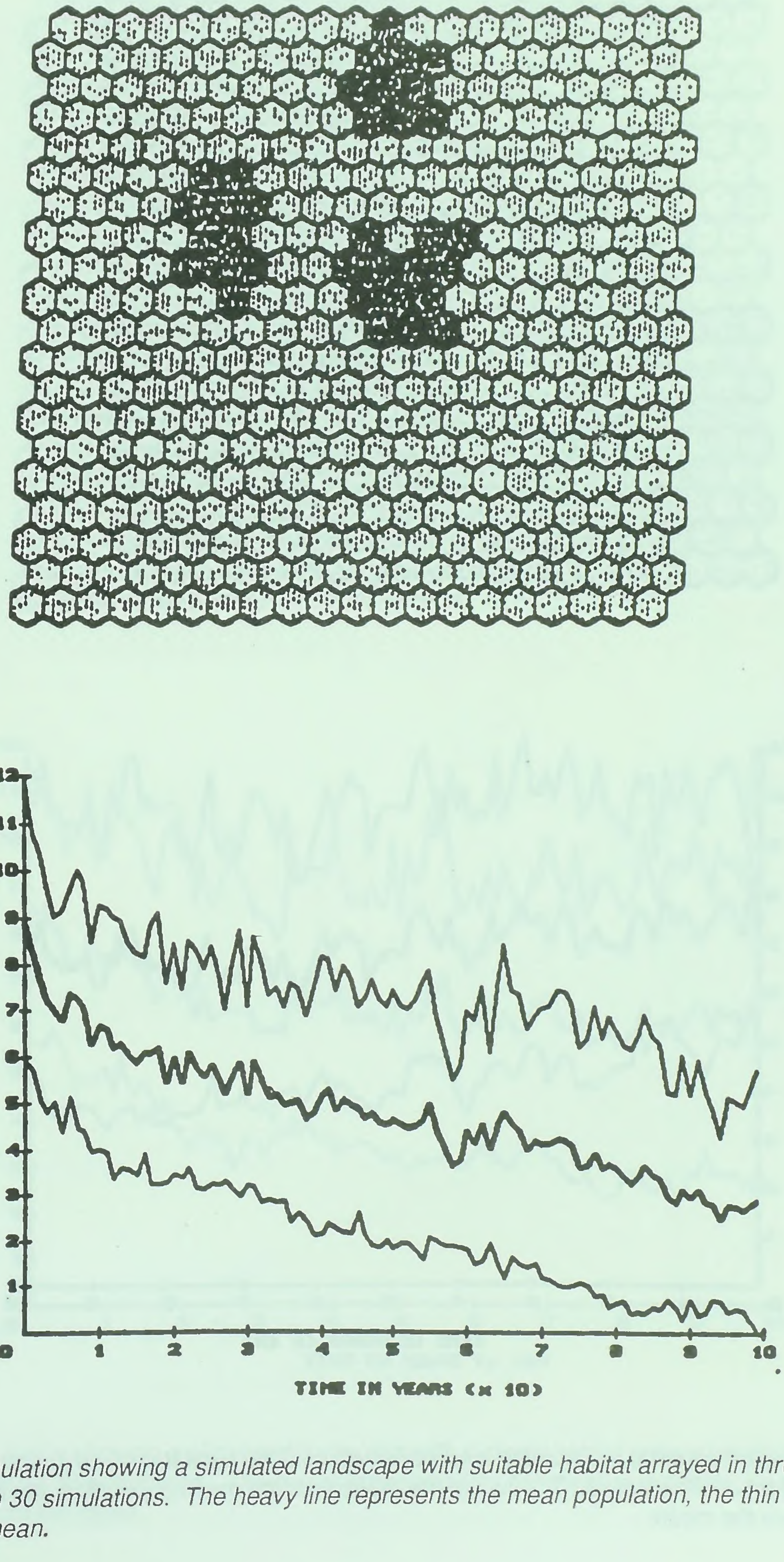


Figure 7. *Model simulation showing a simulated landscape with suitable habitat arrayed in three small blocks. The results are based on 30 simulations. The heavy line represents the mean population, the thin lines are one standard deviation from the mean.*

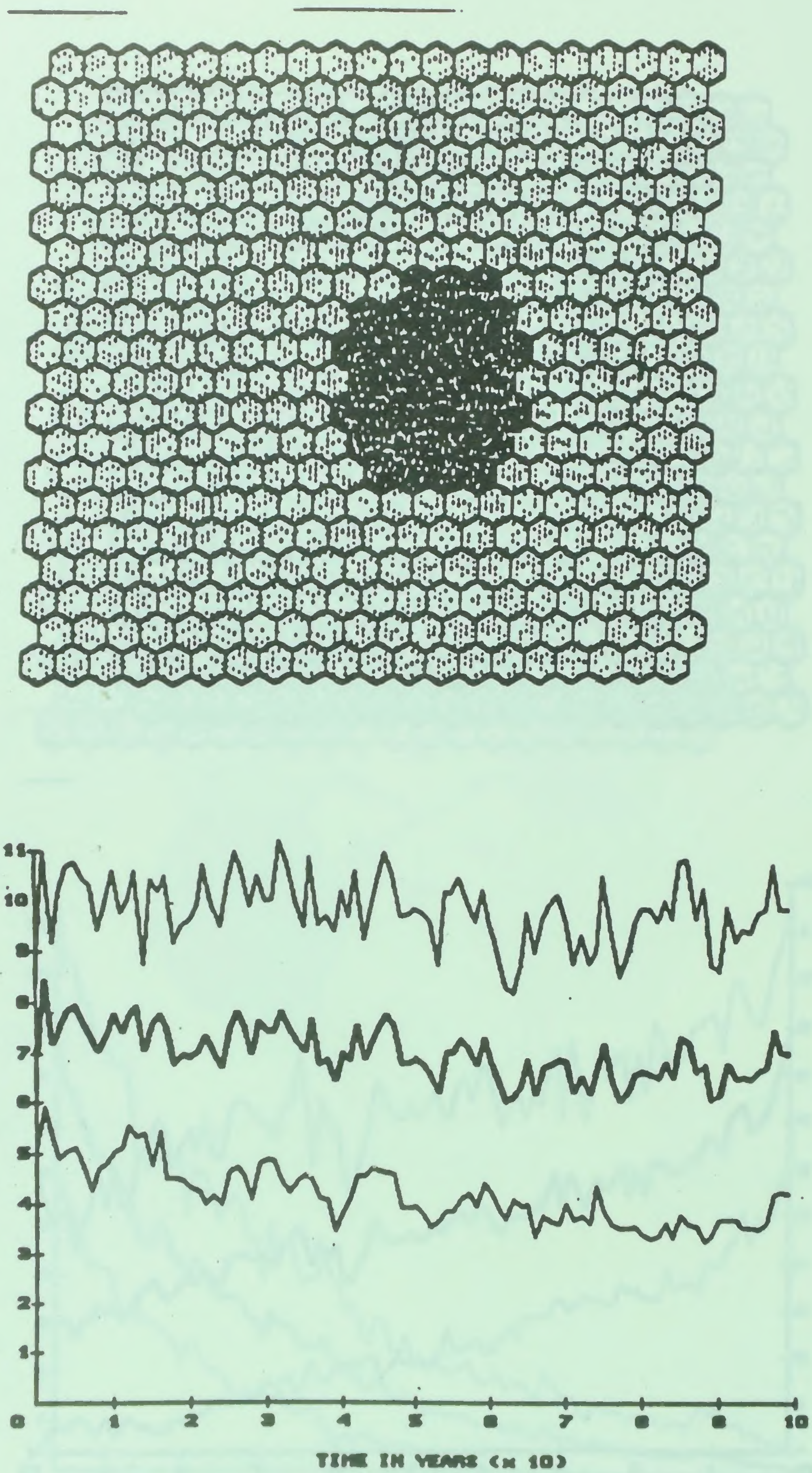
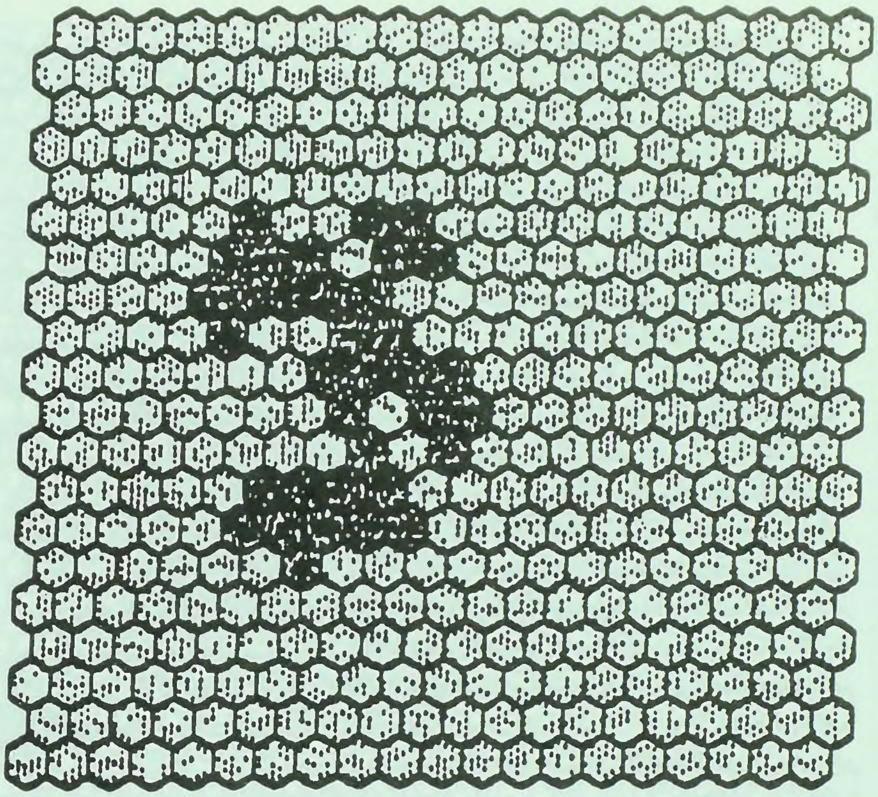


Figure 8. Model simulation showing a simulated landscape with suitable habitat arrayed in one large regular block. The results are based on 30 simulations. The heavy line represents the mean population, the thin lines are one standard deviation from the mean.



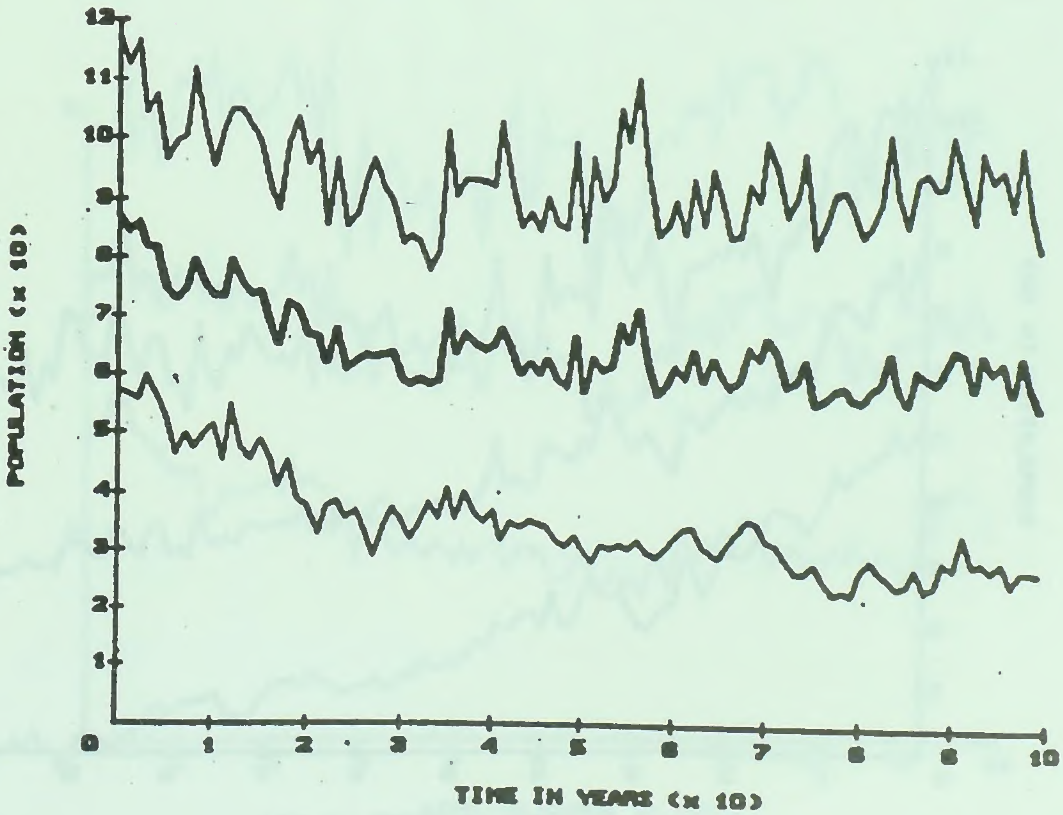
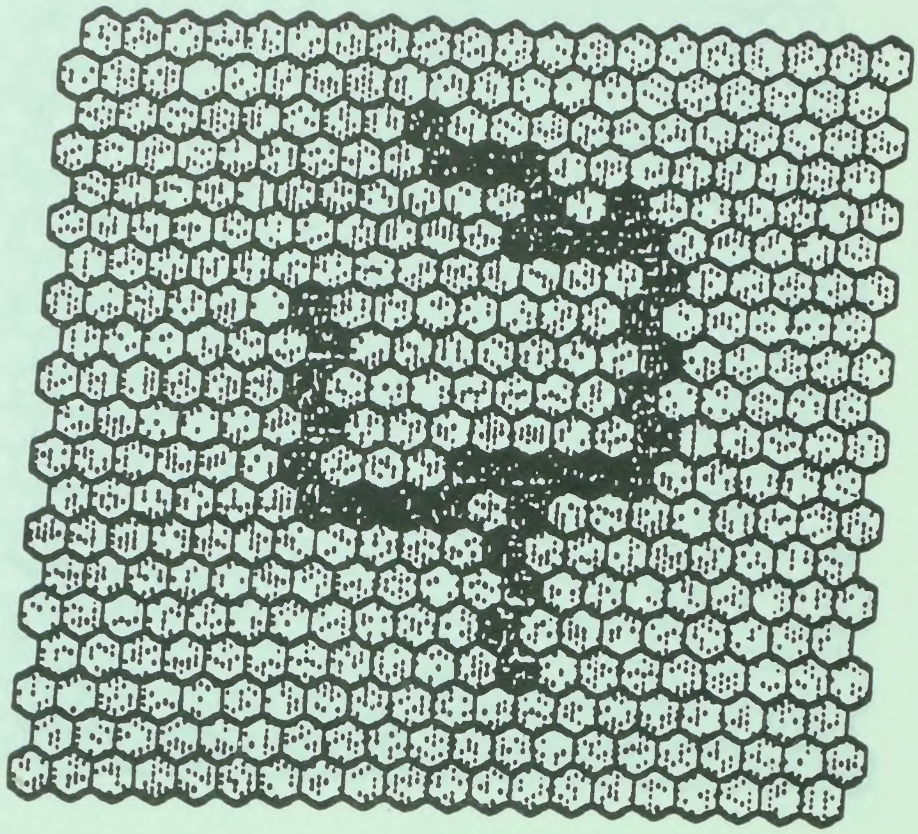


Figure 9. *Model simulation showing a simulated landscape with suitable habitat arrayed in one large irregular block. The results are based on 30 simulations. The heavy line represents the mean population, the thin lines are one standard deviation from the mean.*



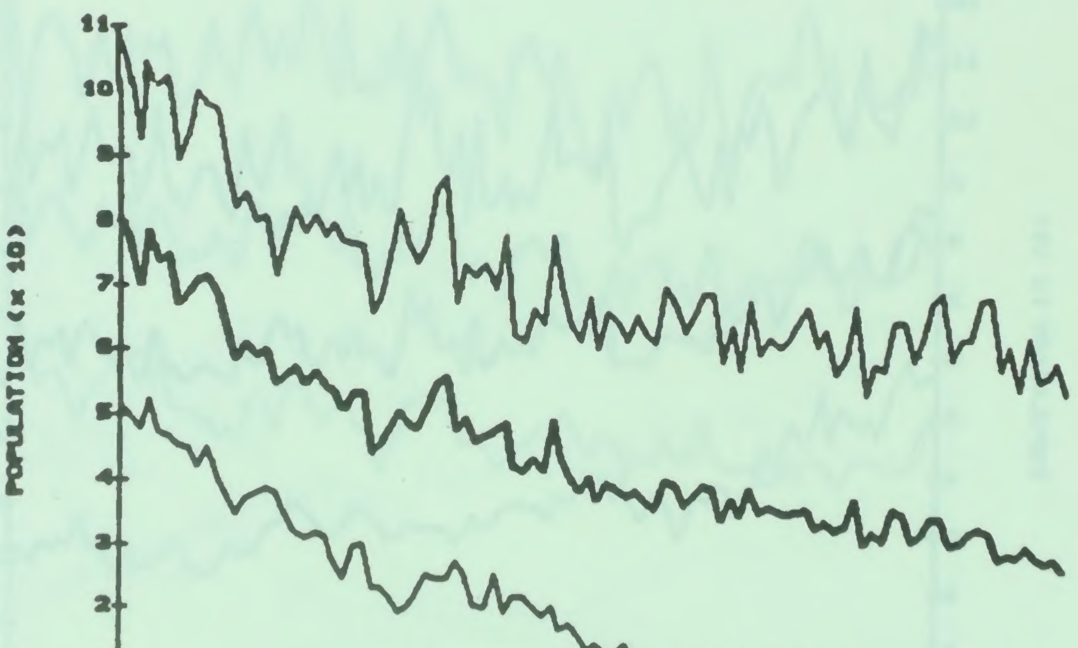


Figure 10. Model simulation showing a simulated landscape with suitable habitat arrayed in one very irregular block. this block is similar in form to reserves that consist of riparian corridors. The results are based on 30 simulations. The heavy line represents the mean population, the thin lines are one standard deviation from the mean.

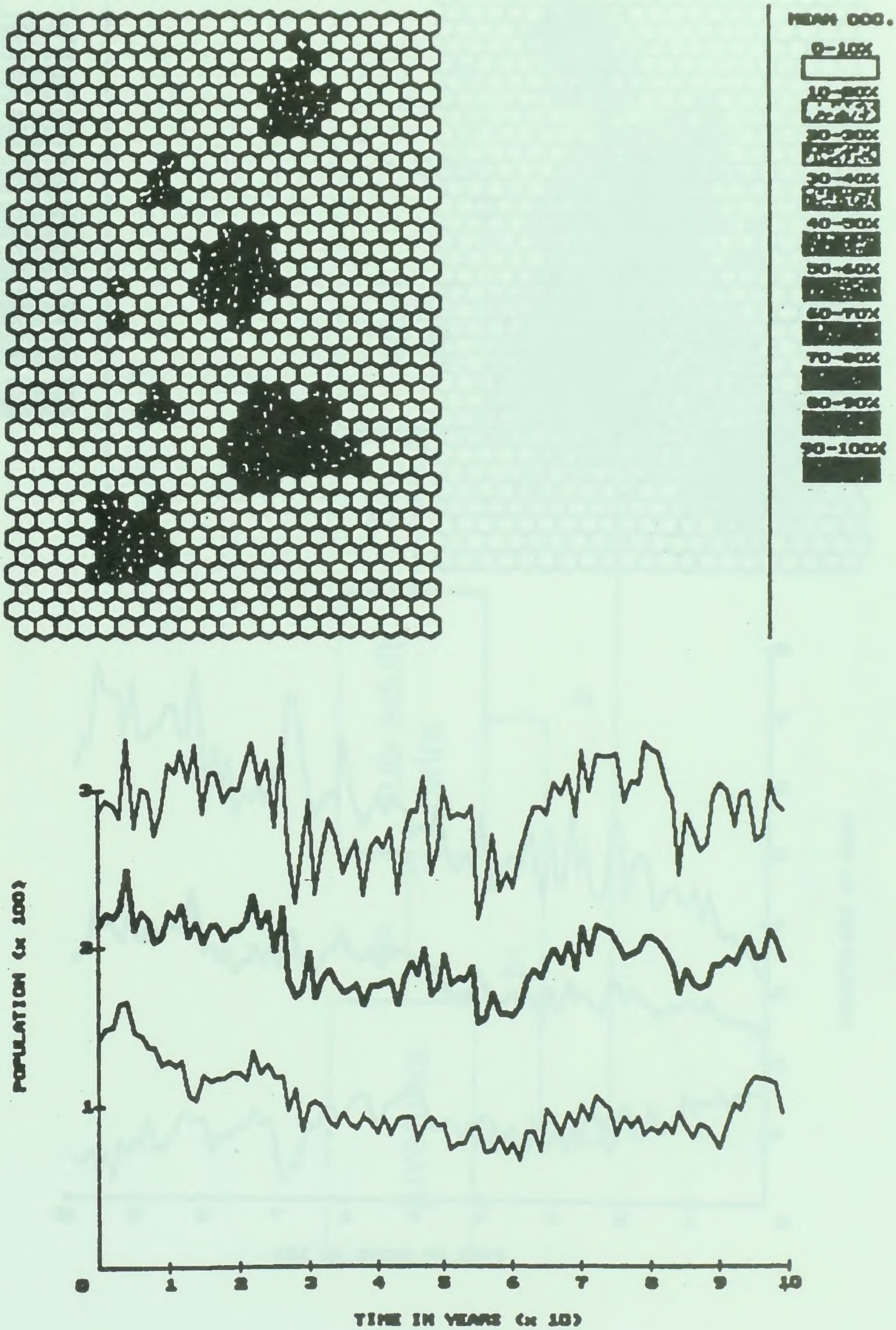


Figure 11. *Model simulation showing a simulated landscape with suitable habitat with a reserve system consisting of clusters of suitable habitat surrounded by unsuitable habitat. The population was initialized results are based on 30 simulations. Mean occupancy is the proportion of the time that pairs occupied the site. The heavy line represents the mean population, the thin lines are one standard deviation from the mean.*

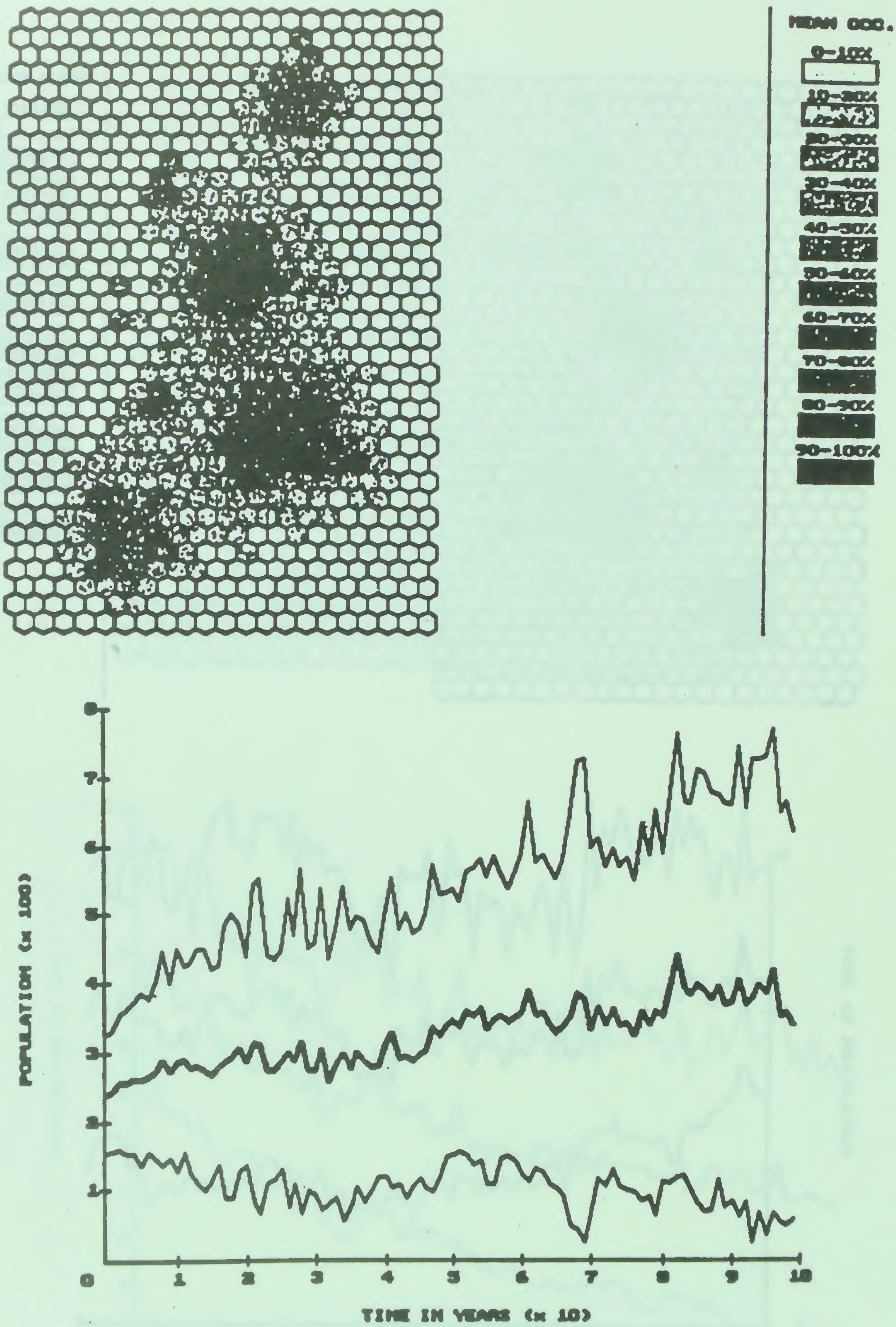


Figure 12. *Model simulation showing a simulated landscape with suitable habitat with a reserve system consisting of clusters of suitable habitat surrounded by marginal habitat. The population was initialized results are based on 30 simulations. Mean occupancy is the proportion of the time that pairs occupied the site. The heavy line represents the mean population, the thin lines are one standard deviation from the mean.*

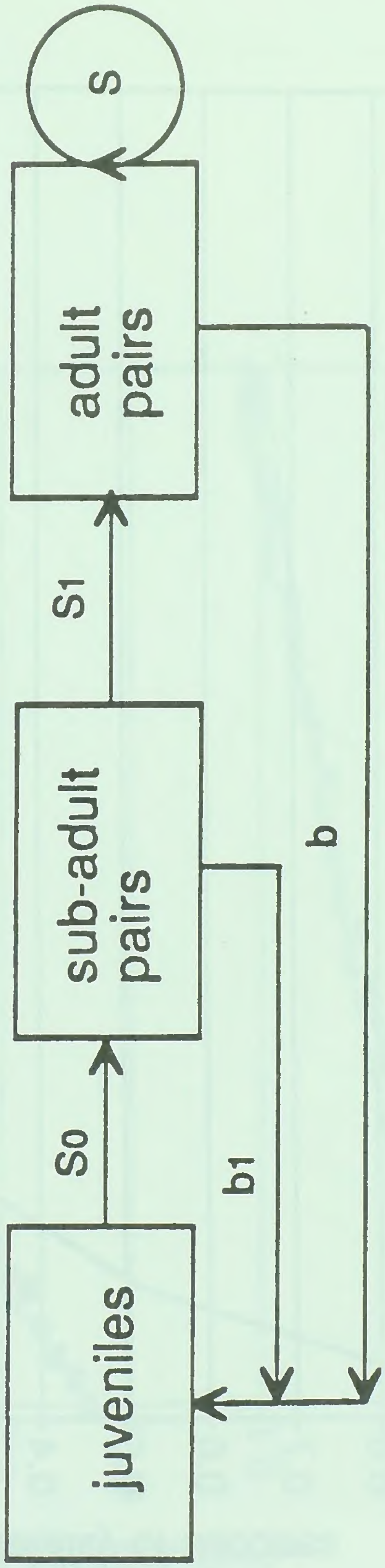


Figure 13. ***A*** *flow diagram representing the life history structure used in s linear stage-structured matrix model.*

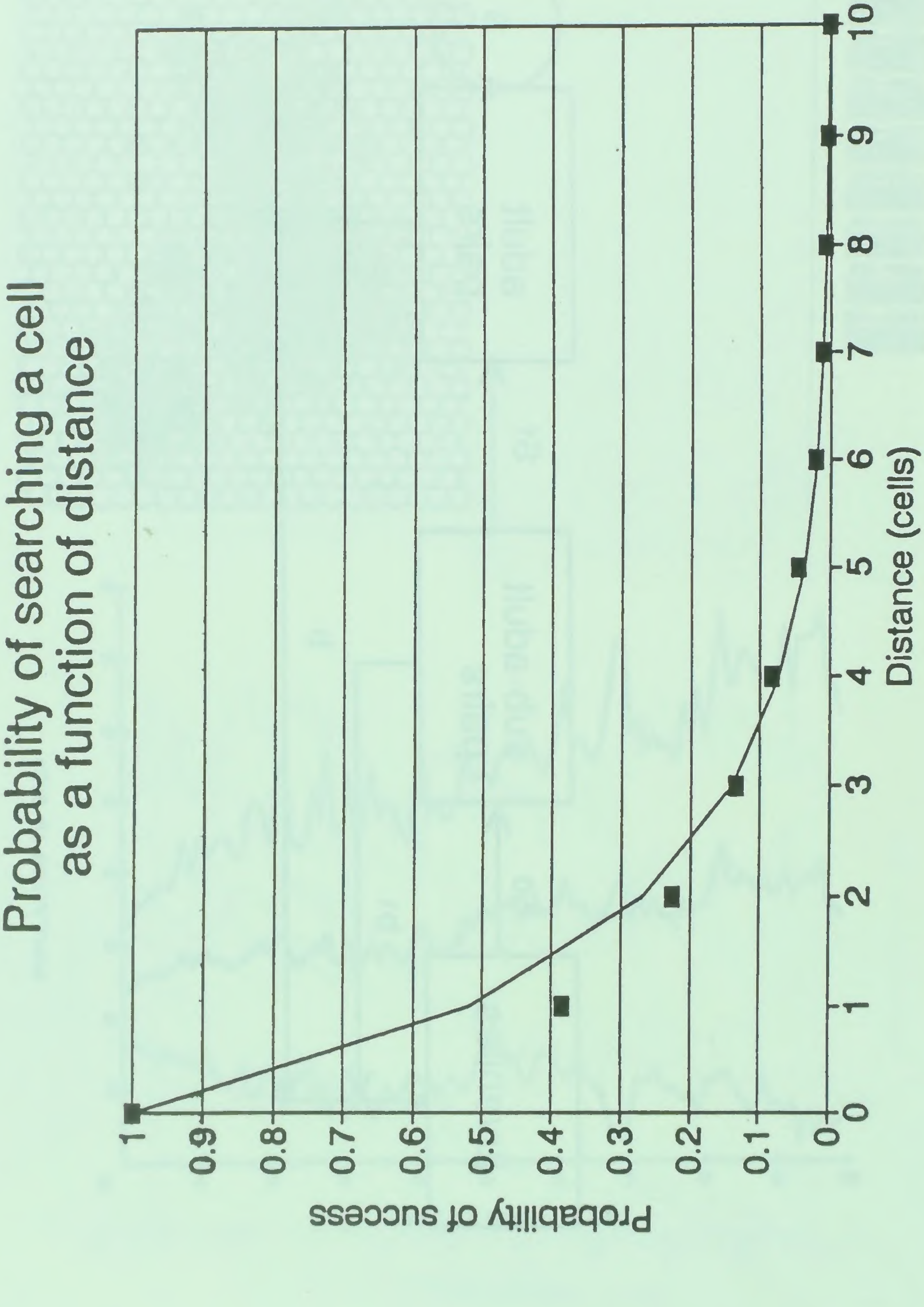


Figure 14. The probability that an organism searches a cell given 20 searches. The search pattern is a pure random walk. The line is a best-fit exponential function.

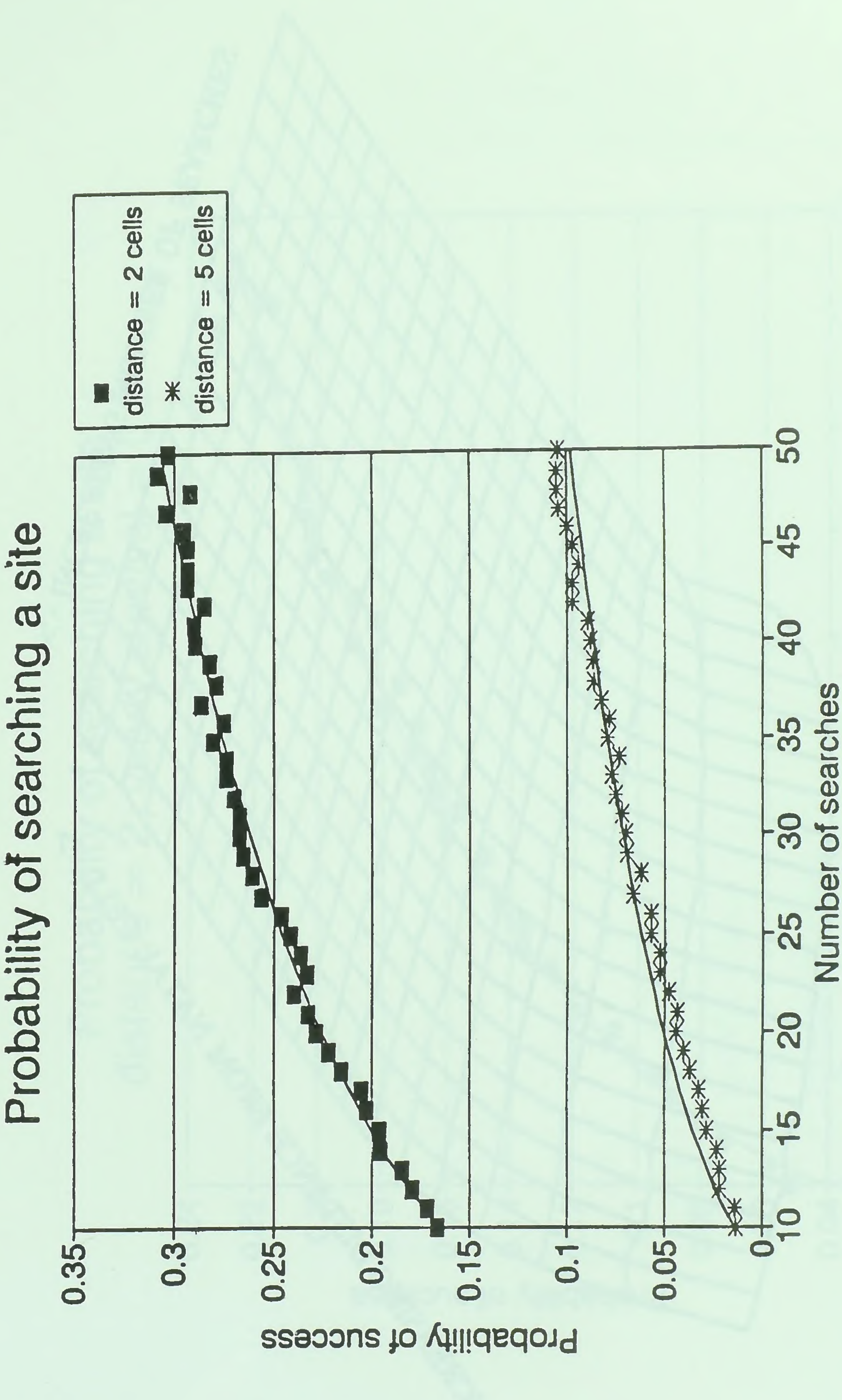


Figure 15. *The probability of searching a site, changing the number of searches. The probability of searching a site 2 cells away is greater given 10 searches than the probability of searching a site 5 cells away is given 50 searches.*

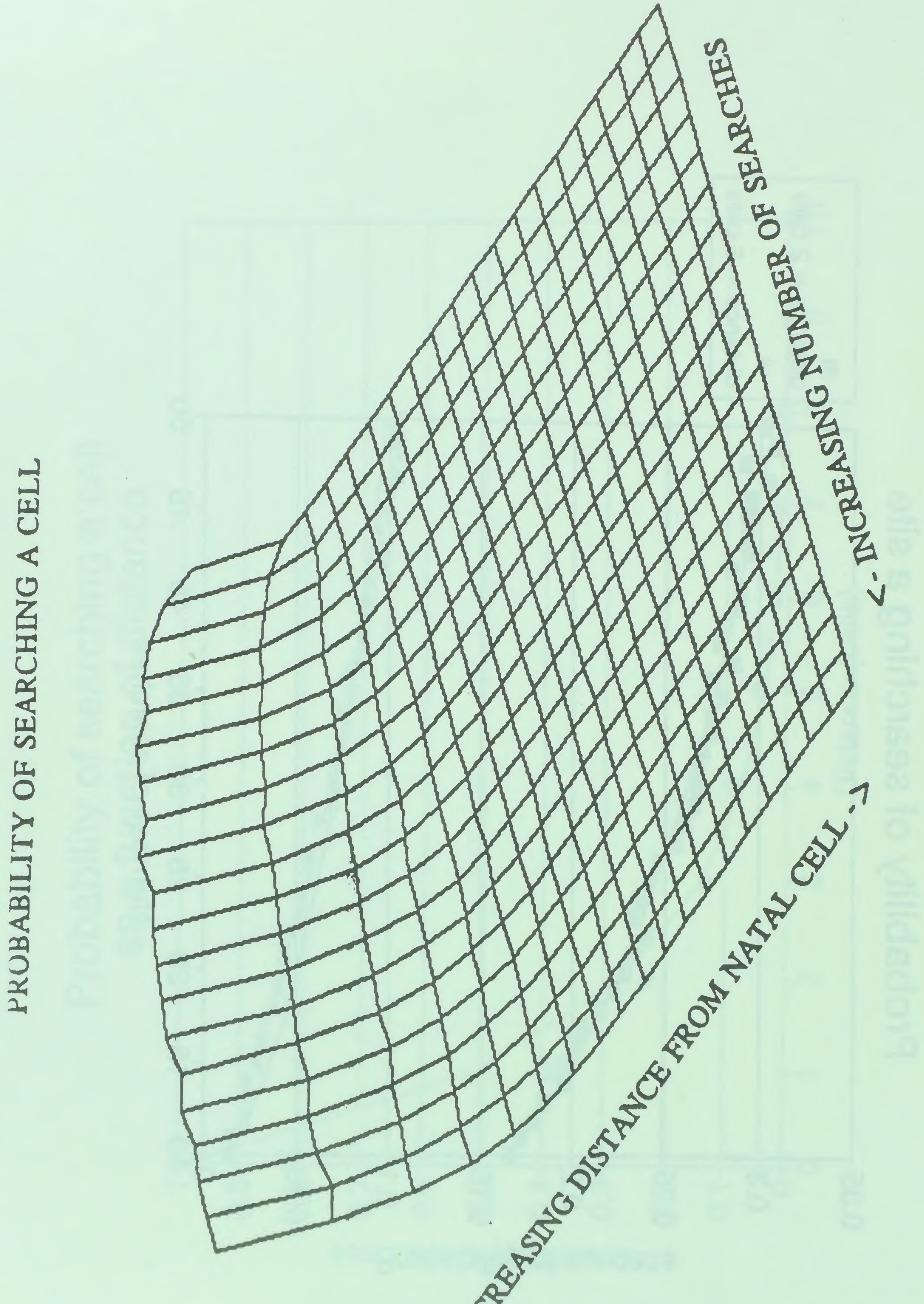


Figure 16. *A three-dimensional representation of the probability of searching a cell. Distance from the natal cell dominates the probability function.*

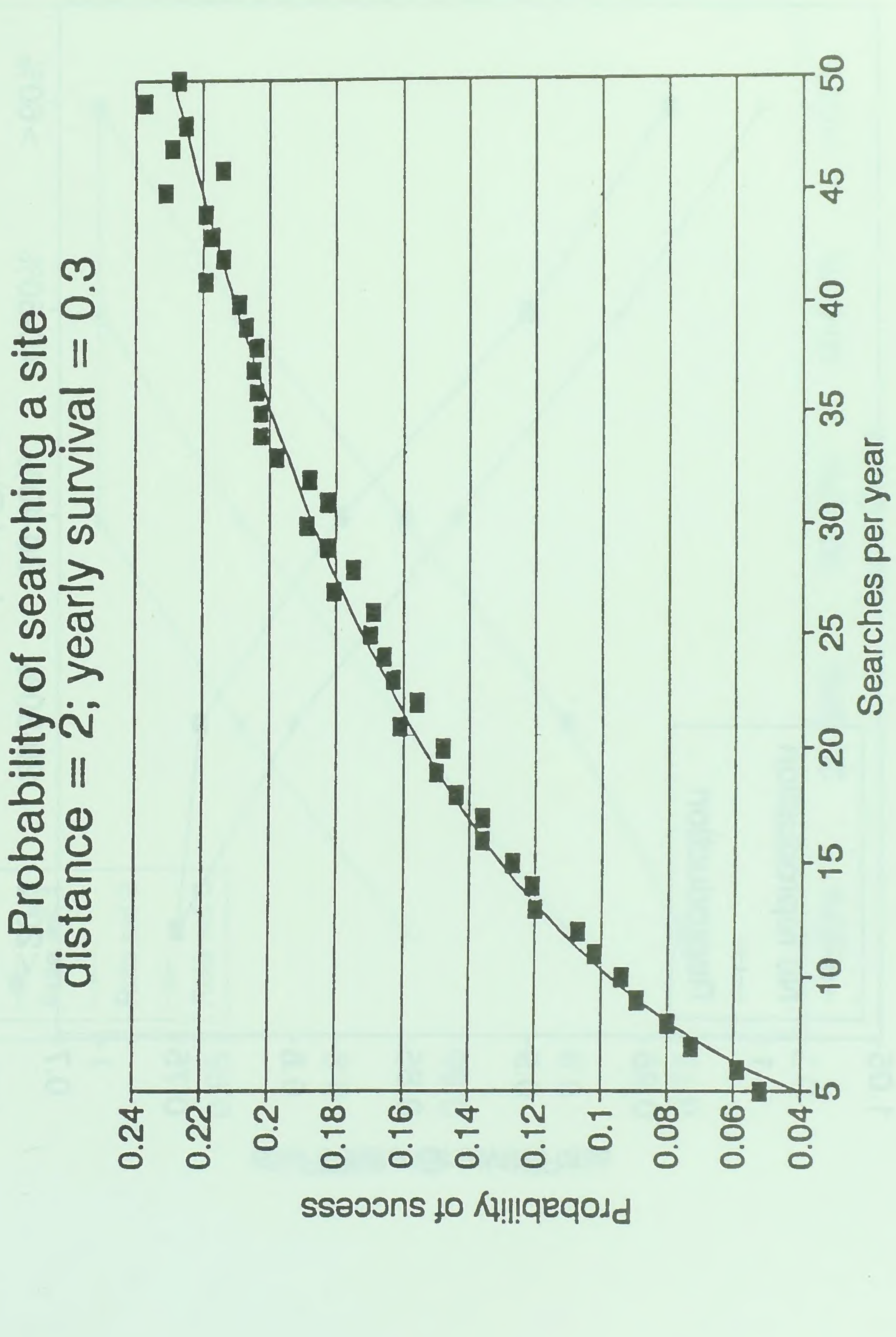


Figure 17. *The probability of searching a site with constant mortality. Here, the yearly risk is pro-rated across the number of steps-per-year. The bird searches until the target cell is found or the bird dies.*

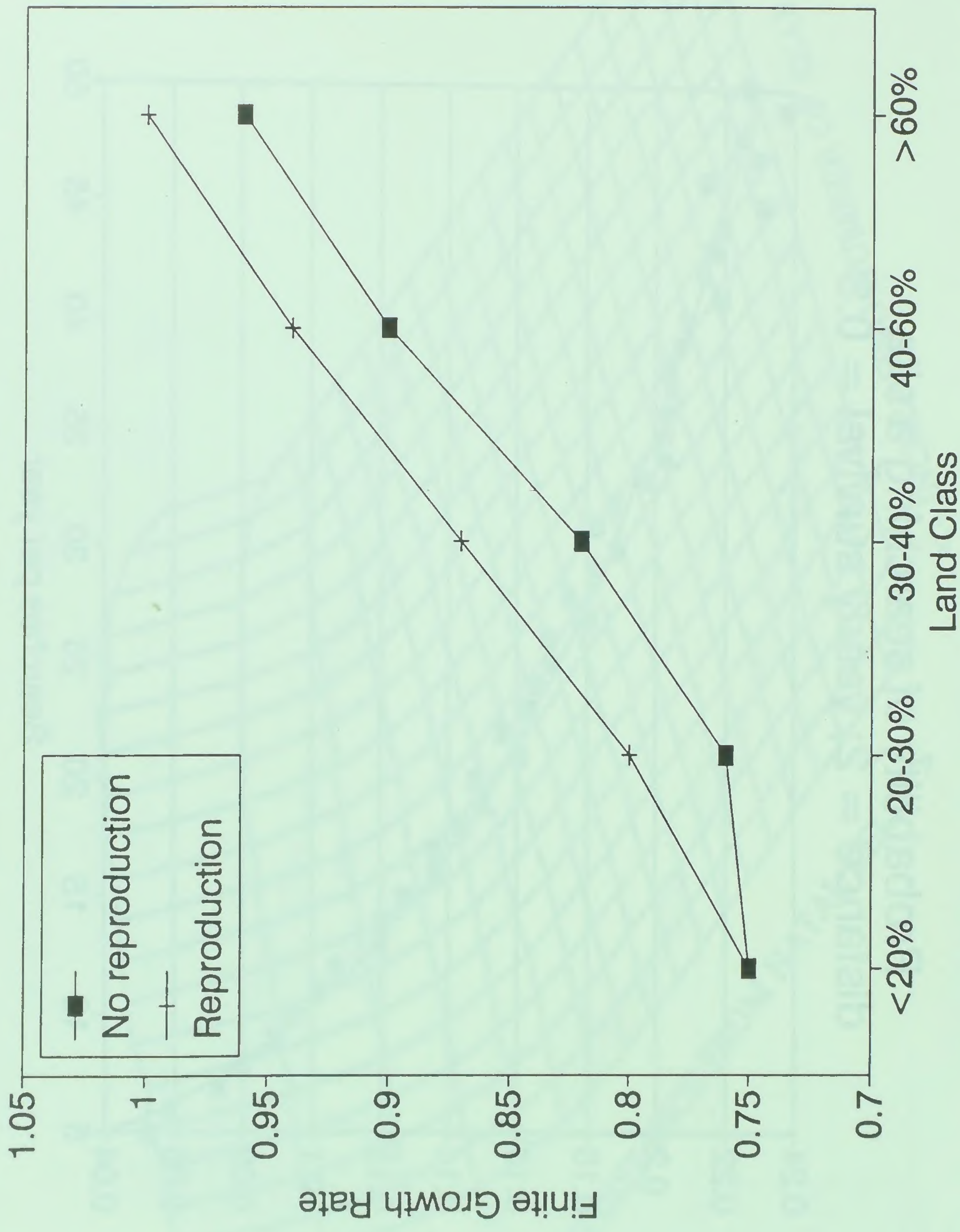


Figure 18. *The modeled finite rate of increase (1) associated with a population of spotted owls occupying habitat having varying percentages of mature forest. Values derived from parameters presented in Table 5.*

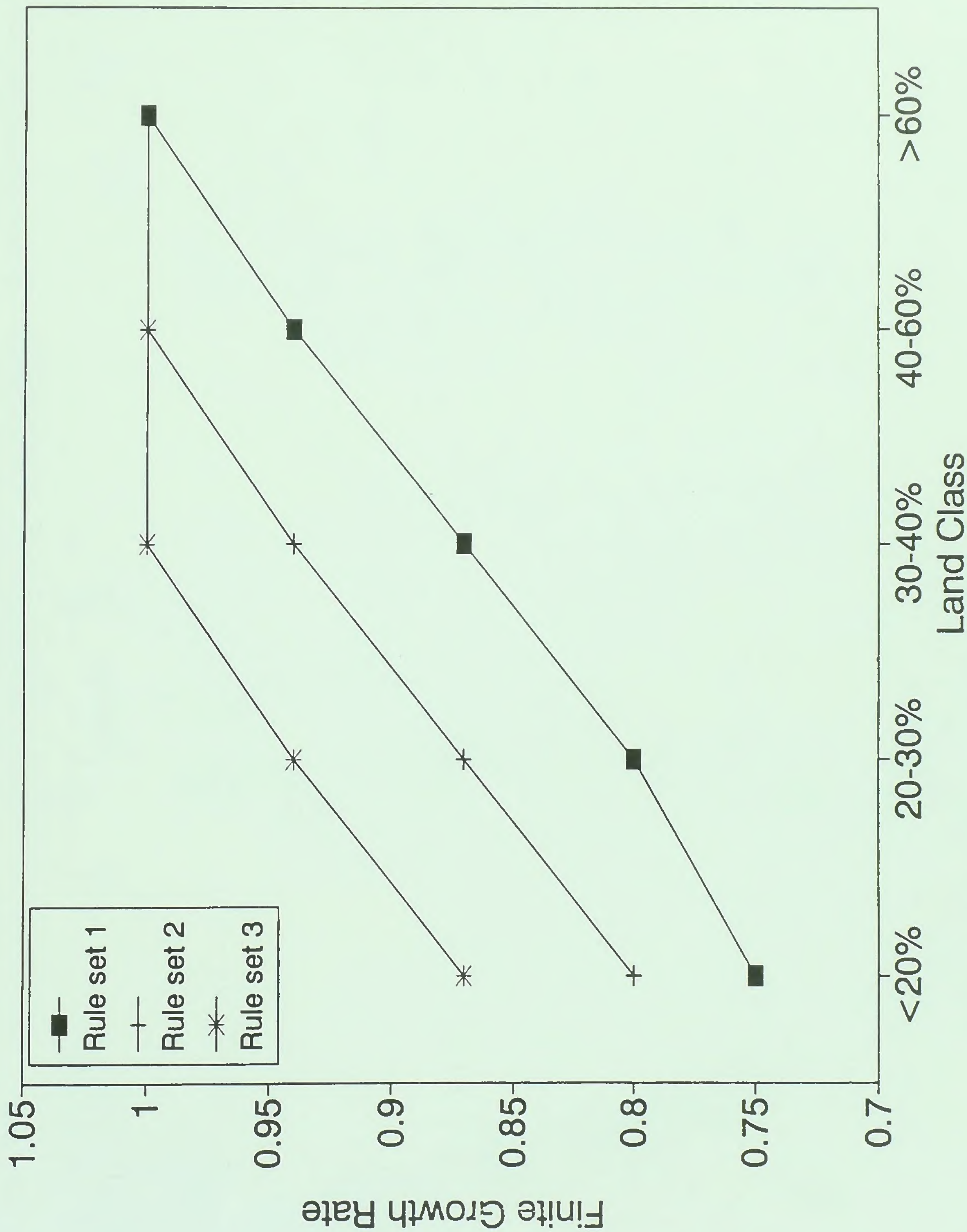
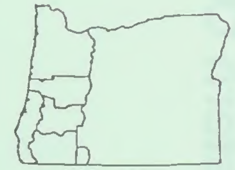


Figure 19. *Modeled l associated with habitat quality. Rule set 3 shows the least sensitivity to the quantity of suitable habitat on the landscape.*

Appendix 4-20.
Hexagon Plots for Western Oregon.

U.S. DEPARTMENT OF INTERIOR

Bureau of Land Management
Western Oregon - Draft 1992 RMP/EIS



0-100% BLM OWNERSHIP

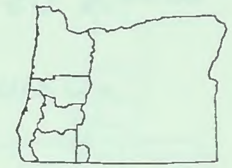
40-100% OWNERSHIP

60-100% OWNERSHIP

Percent BLM Ownership within 2500 acre Hexagons

U.S. DEPARTMENT OF INTERIOR

Bureau of Land Management
Western Oregon - Draft 1992 RMP/EIS

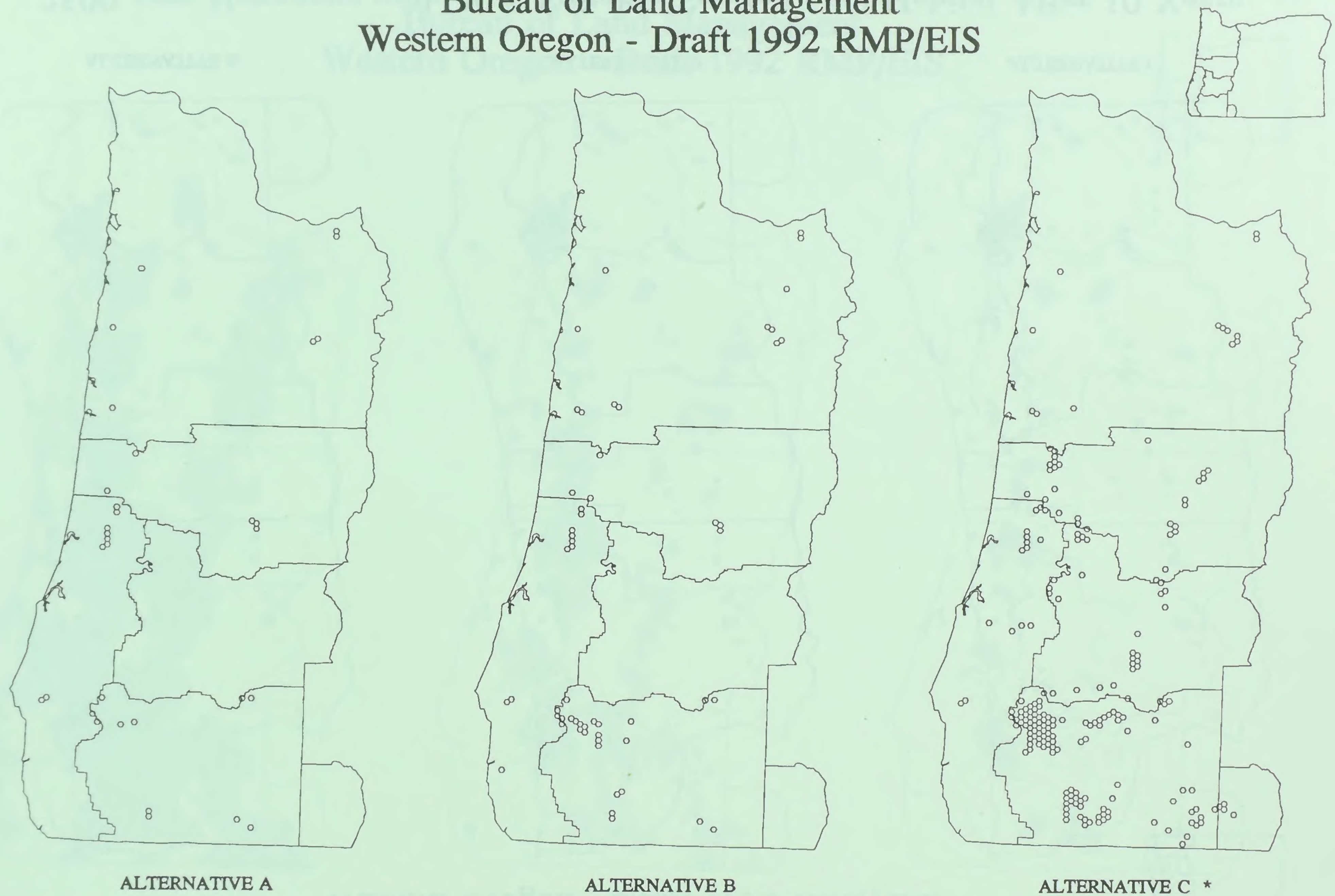


ALTERNATIVE A ALTERNATIVE B ALTERNATIVE C

2500 acre Hexagons with 40% Suitable Spotted Owl Habitat After 10 Years

U.S. DEPARTMENT OF INTERIOR

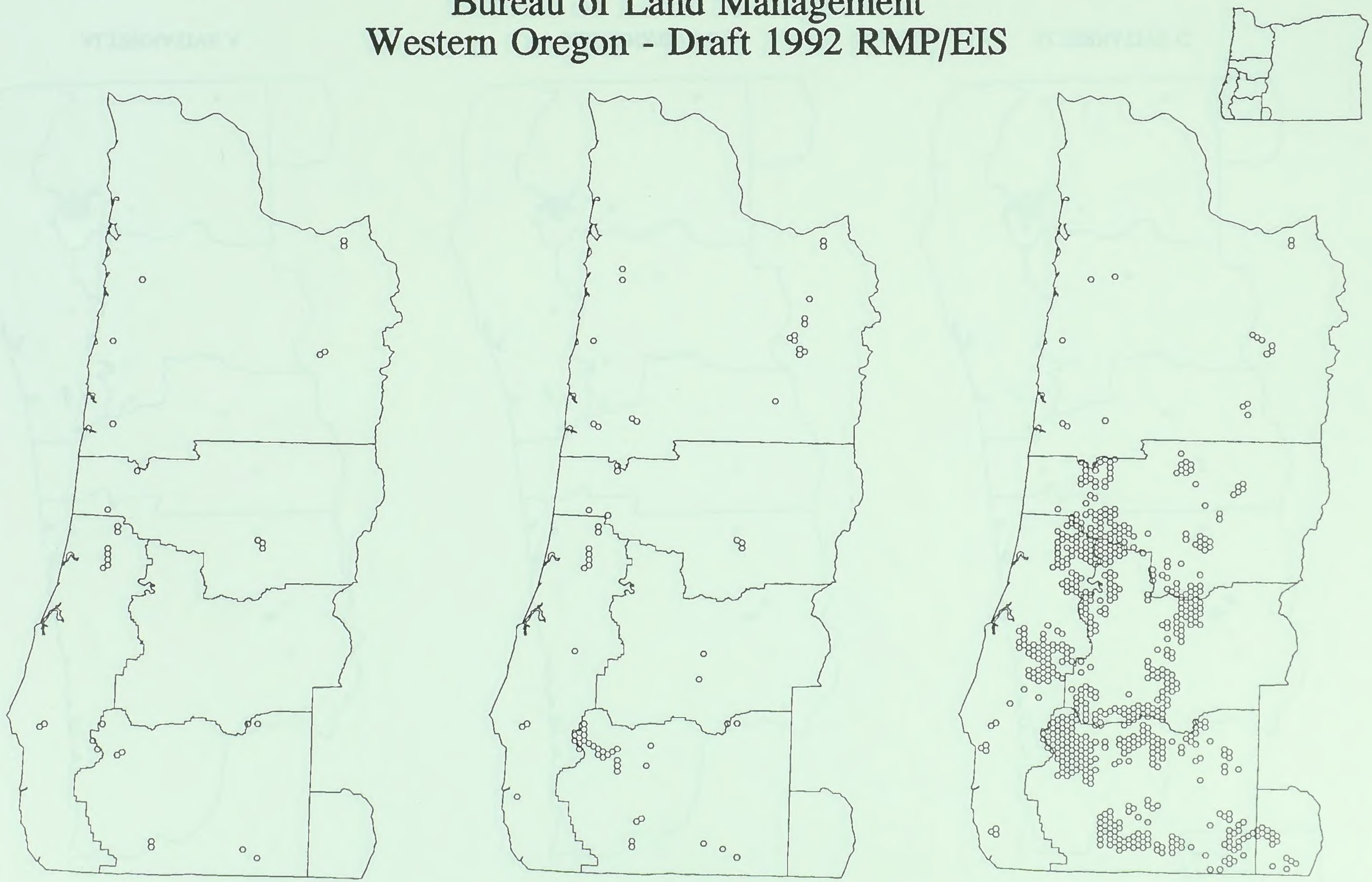
Bureau of Land Management
Western Oregon - Draft 1992 RMP/EIS



2500 acre Hexagons with 40% Suitable Spotted Owl Habitat After 50 Years

* ALTERNATIVE C - AFTER 70 YEARS

U.S. DEPARTMENT OF INTERIOR
Bureau of Land Management
Western Oregon - Draft 1992 RMP/EIS

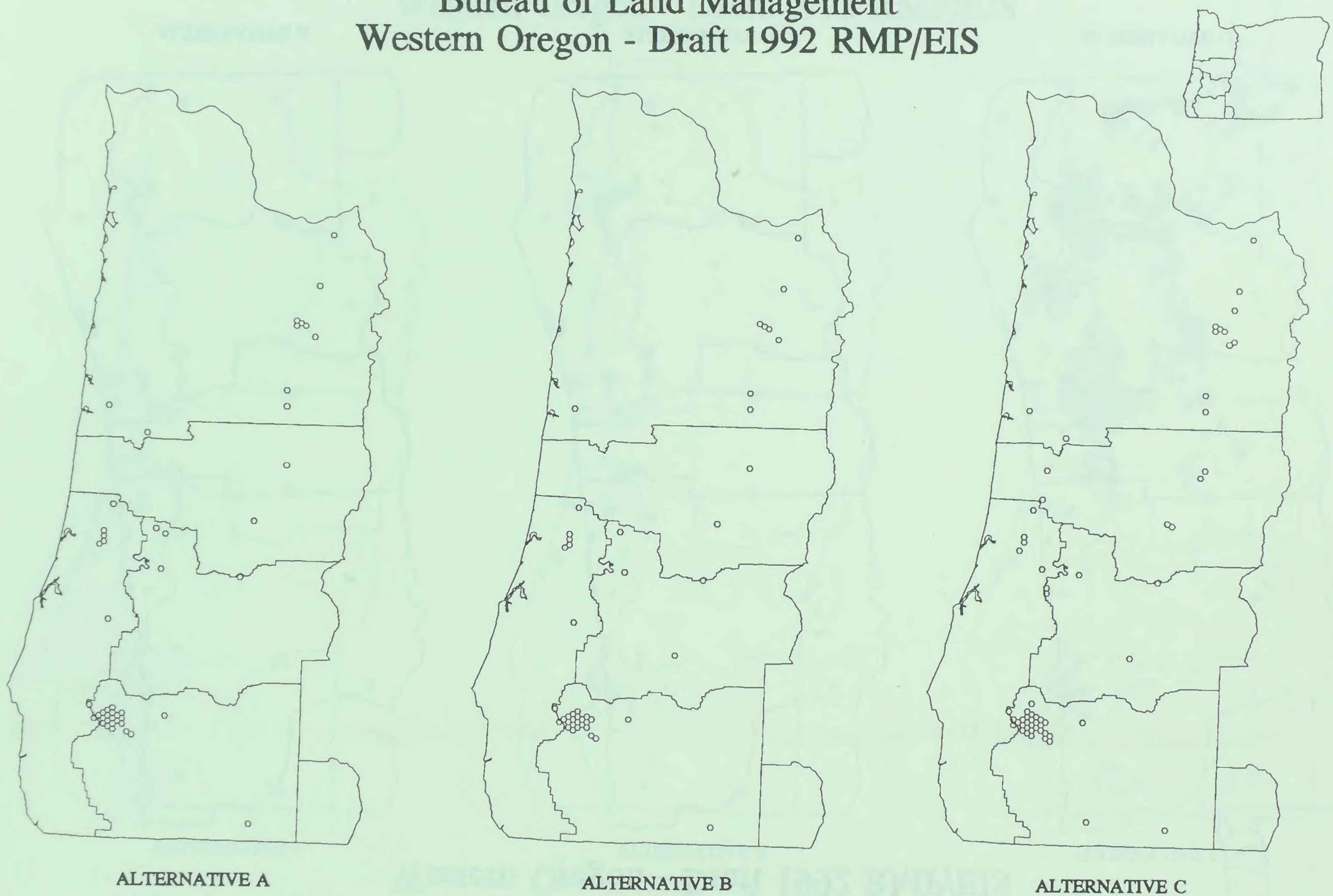


ALTERNATIVE A — ALTERNATIVE B — ALTERNATIVE C

2500 acre Hexagons with 40% Suitable Spotted Owl Habitat After 100 Years

U.S. DEPARTMENT OF INTERIOR

Bureau of Land Management
Western Oregon - Draft 1992 RMP/EIS

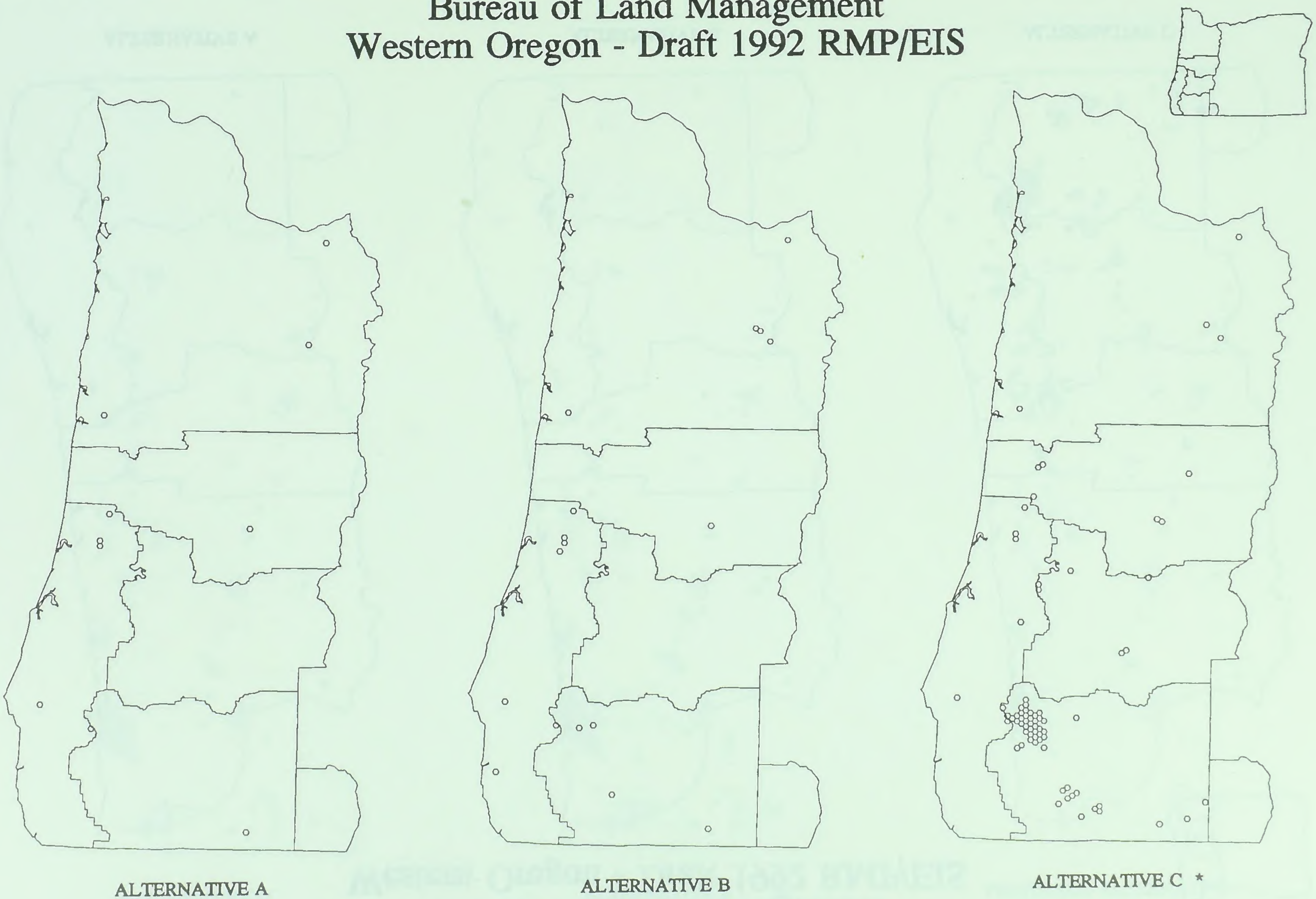


2500 acre Hexagons with 60% Suitable Spotted Owl Habitat After 10 Years

U.S. DEPARTMENT OF INTERIOR

Bureau of Land Management

Western Oregon - Draft 1992 RMP/EIS



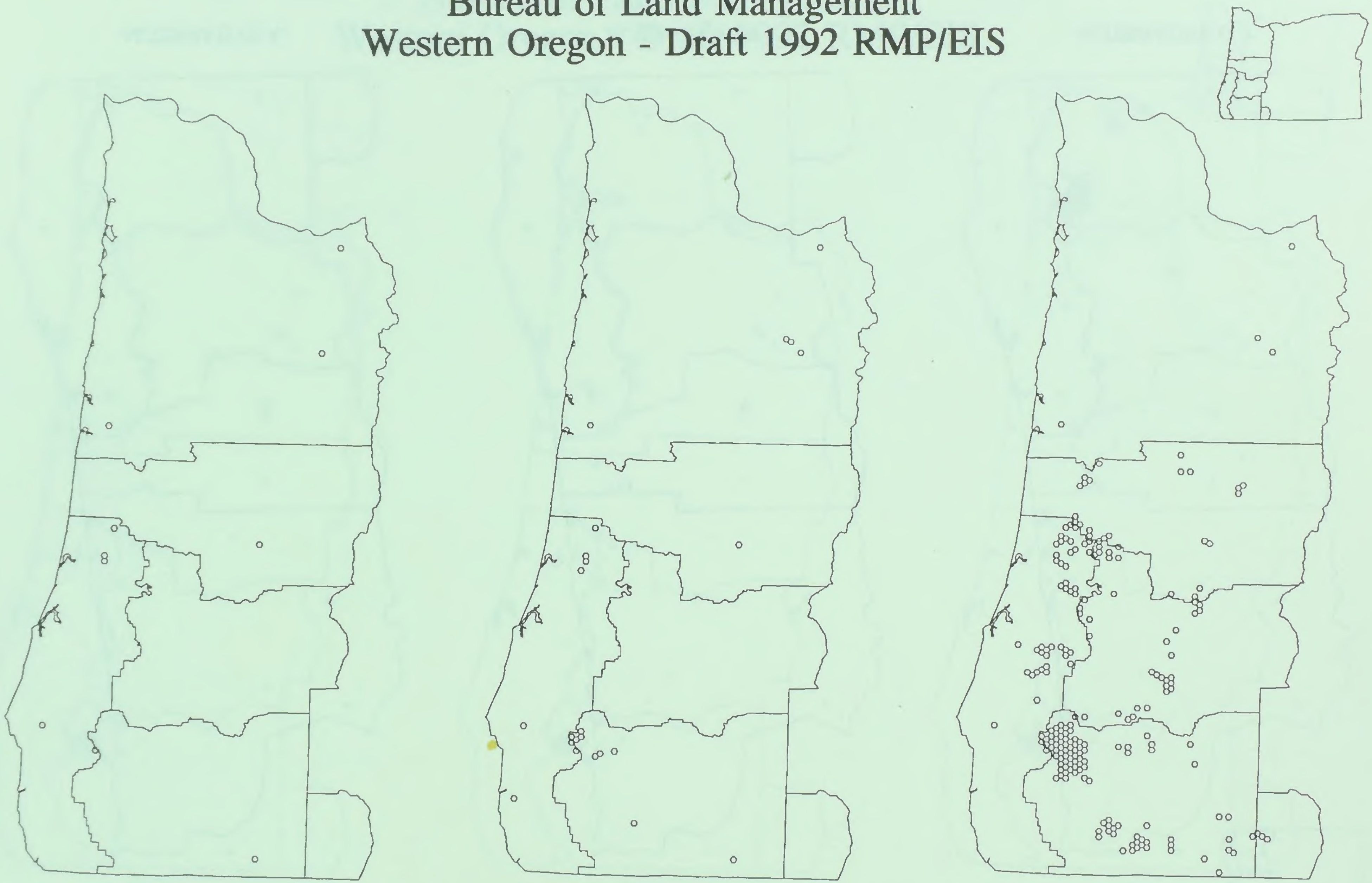
2500 acre Hexagons with 60% Suitable Spotted Owl Habitat After 50 Years

* ALTERNATIVE C - AFTER 70 YEARS

U.S. DEPARTMENT OF INTERIOR

Bureau of Land Management

Western Oregon - Draft 1992 RMP/EIS



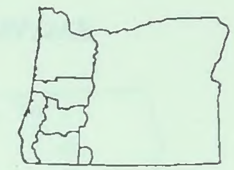
ALTERNATIVE A ALTERNATIVE B ALTERNATIVE C

2500 acre Hexagons with 60% Suitable Spotted Owl Habitat After 100 Years

U.S. DEPARTMENT OF INTERIOR

Bureau of Land Management

Western Oregon - Draft 1992 RMP/EIS



ALTERNATIVE D

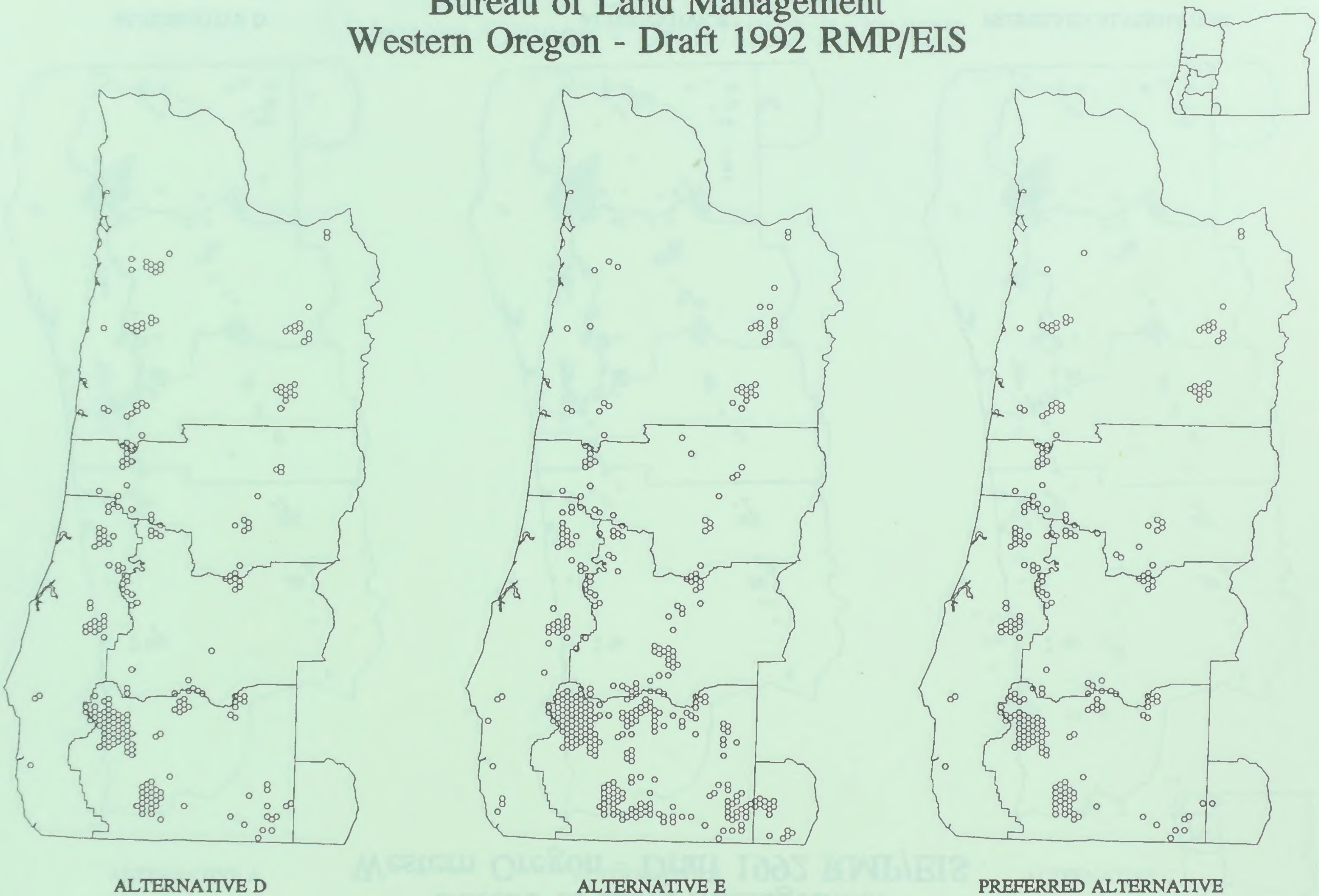
ALTERNATIVE E

PREFERRED ALTERNATIVE

2500 acre Hexagons with 40% Suitable Spotted Owl Habitat After 10 Years

U.S. DEPARTMENT OF INTERIOR

Bureau of Land Management
Western Oregon - Draft 1992 RMP/EIS

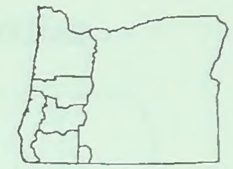


2500 acre Hexagons with 40% Suitable Spotted Owl Habitat After 70 Years

U.S. DEPARTMENT OF INTERIOR

Bureau of Land Management

Western Oregon - Draft 1992 RMP/EIS



ALTERNATIVE D

ALTERNATIVE E

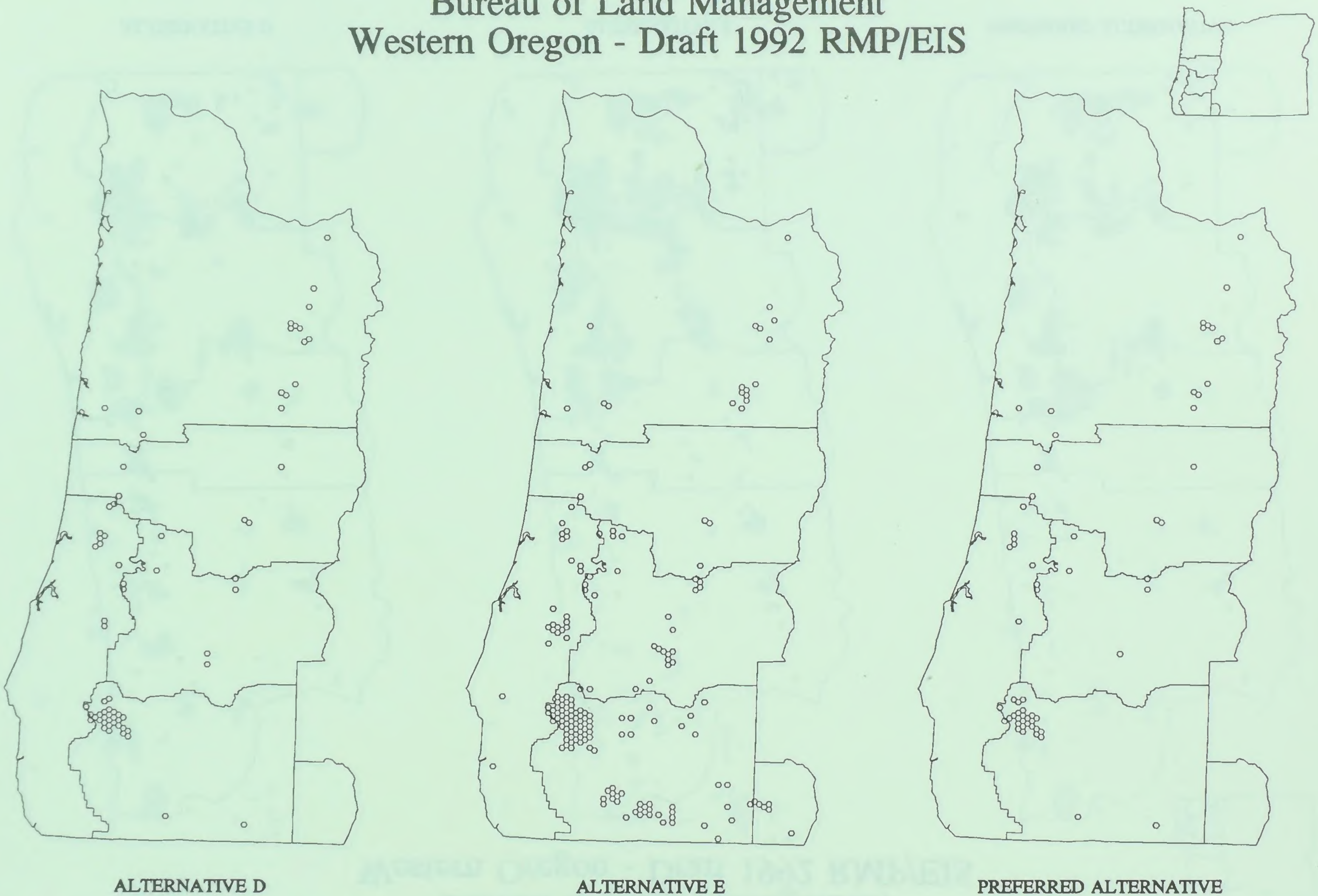
PREFERRED ALTERNATIVE

2500 acre Hexagons with 40% Suitable Spotted Owl Habitat After 100 Years

U.S. DEPARTMENT OF INTERIOR

Bureau of Land Management

Western Oregon - Draft 1992 RMP/EIS

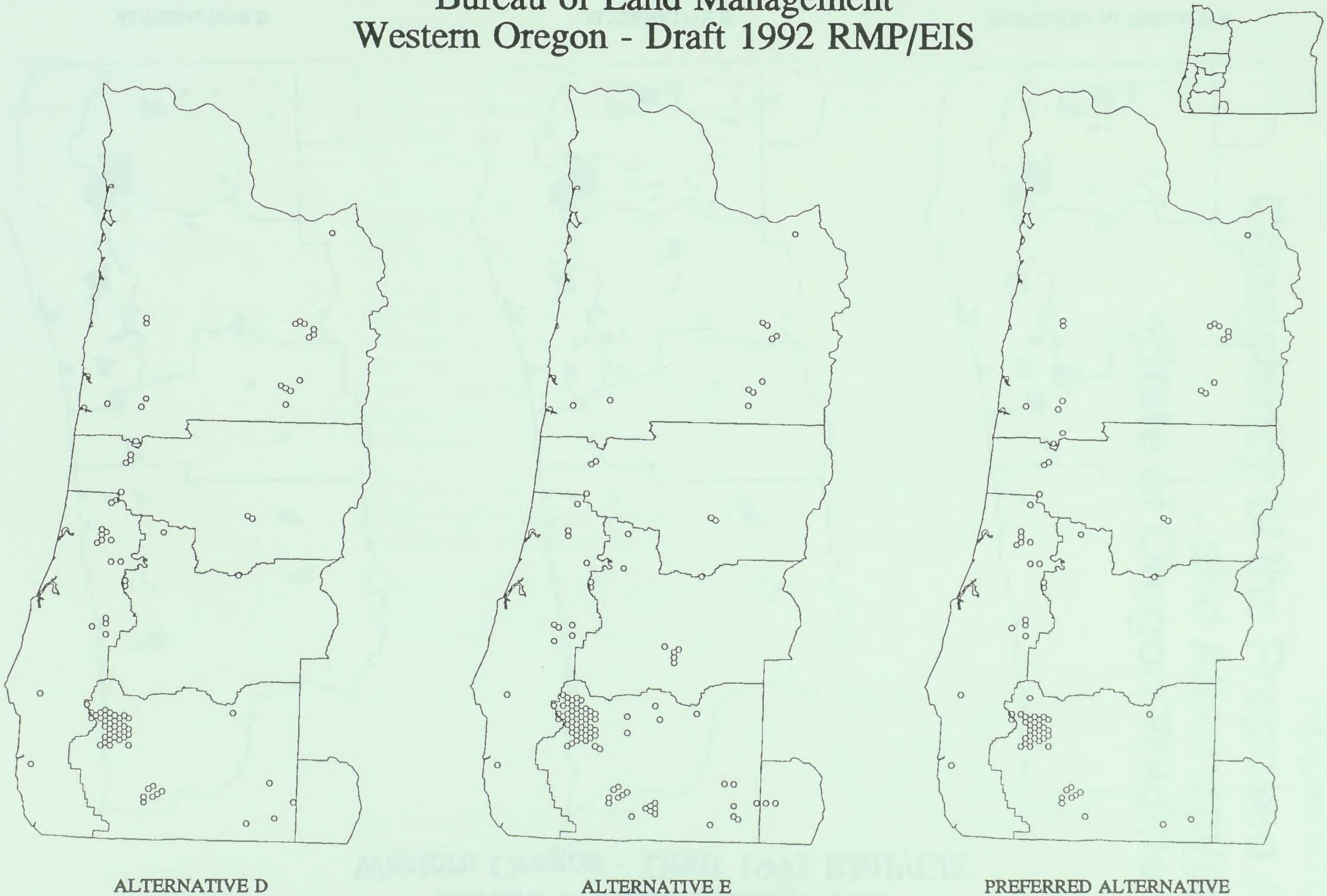


2500 acre Hexagons with 60% Suitable Spotted Owl Habitat After 10 Years

U.S. DEPARTMENT OF INTERIOR

Bureau of Land Management

Western Oregon - Draft 1992 RMP/EIS

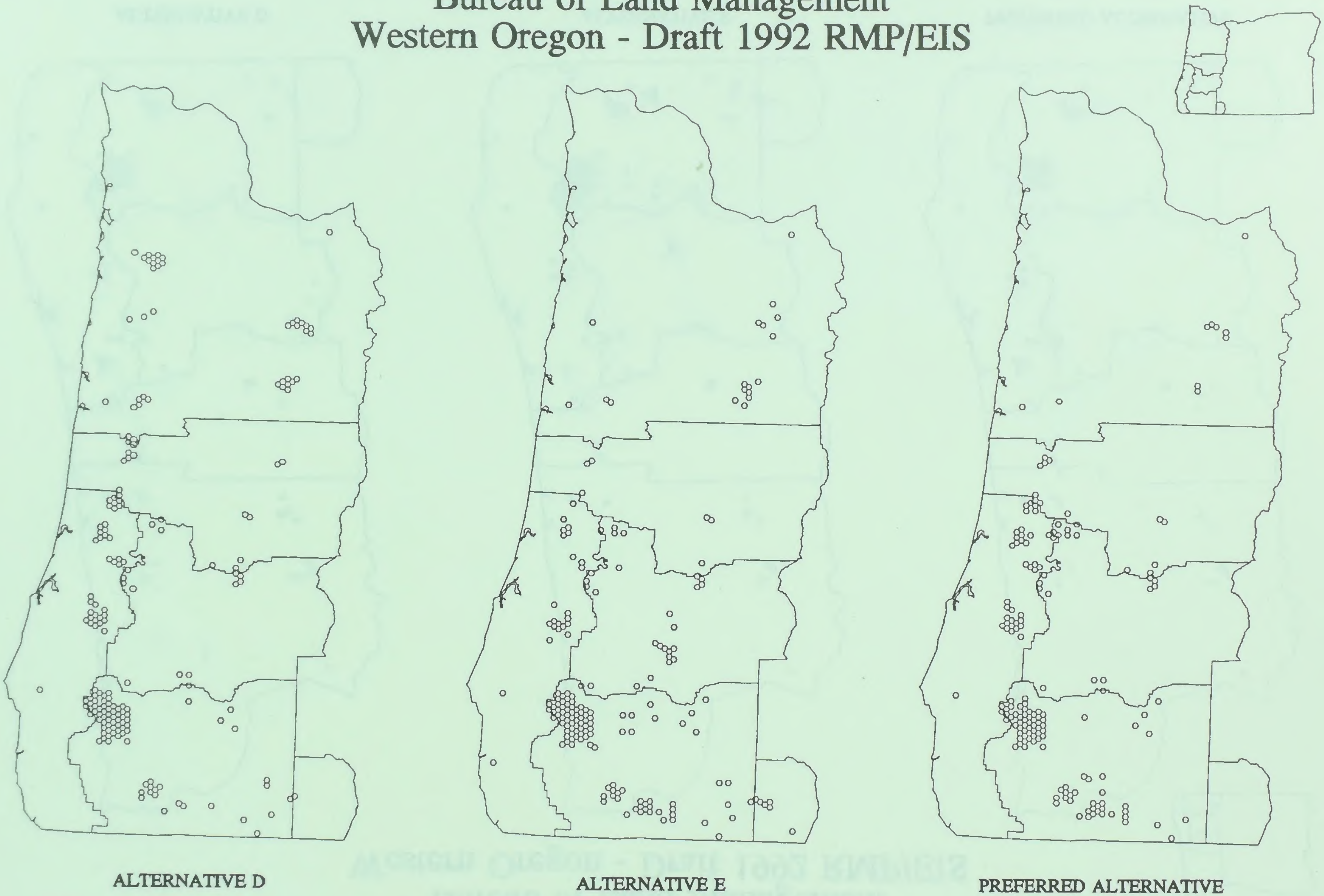


2500 acre Hexagons with 60% Suitable Spotted Owl Habitat After 70 Years

U.S. DEPARTMENT OF INTERIOR

Bureau of Land Management

Western Oregon - Draft 1992 RMP/EIS



2500 acre Hexagons with 60% Suitable Spotted Owl Habitat After 100 Years

Appendix 4-21
Consistency of the Proposed Action and Alternatives with State of Oregon Wildlife Plans

Consistency of the Proposed Action and Alternatives with State of Oregon Wildlife Plans

State Plan/Statute	Objective	Consistency of Alternatives
Oregon Statutory Wildlife Policy, Revised Statute 496.012	Maintain all species of wildlife at optimum levels and prevent the serious depletion of any indigenous species.	Alternatives NA, A, and B could lead to substantial depletion of those populations of species heavily dependent on older forest habitat, that occupy BLM-administered lands in the planning area. (See following discussions of threatened and endangered species and sensitive species). Several alternatives may maintain other populations at less than optimum (see later discussion of big game management objectives).
	Develop and manage the lands and waters of the state in a manner that will enhance the production and public enjoyment of wildlife.	
	Develop and maintain public access to the lands and waters of the state and the wildlife resources thereon.	Public access would be greatest in Alternatives NA, A, and B and more limited by road closures in Alternatives C, D, E, and the PA.
	Regulate wildlife populations and public enjoyment of wildlife in a manner that is compatible with primary uses of the lands and waters of the state and provide optimum public recreational benefits.	
Oregon Threatened and Endangered Species Act	Protect and conserve wildlife species that are determined to be threatened or endangered.	All State listed species found within the Roseburg District are also federally listed under the Endangered Species Act. As such, these species will be protected under the requirements and provisions of the Act.
Oregon's Sensitive Species Rule	Help prevent species from qualifying for listing as threatened or endangered.	Most species on Oregon's sensitive species list would be protected well under Alternatives NA, C, D, E, and the PA, but many would not be well protected under Alternatives A and B. Also see later discussions of wild fish policy and fish plans.

Consistency of the Proposed Action and Alternatives with State of Oregon Wildlife Plans (cont.)

State Plan/Statute	Objective	Consistency of Alternatives
Nongame Wildlife Plan	Maintain populations of naturally occurring Oregon nongame wildlife at self-sustaining levels within natural geographic ranges in a manner which provides for optimum recreational, scientific and cultural benefits, and where possible, is consistent with primary uses of lands and waters of the state.	See preceding discussions.
Big Game Population Management Objectives	Develop, restore and/or maintain big game (along with associated recreational, aesthetic and commercial opportunities and benefits) at the level identified in 1980 as the planning target level by game management unit. This is accomplished through hunting season regulation and implementation of multiple-use management practices on public lands that tend to stabilize the cover-forage relationship in space and time, provide for a wildlife emphasis in management of sensitive wintering areas, and offer habitat improvement opportunities.	Under Alternatives NA, A, and B cover on BLM-administered lands would decline, while under Alternative E forage on BLM-administered lands would decline. In the latter case, however, private lands are expected to provide adequate forage. All alternatives provide for forage seeding. Road closures in Alternatives C, D, E, and PA would improve habitat for elk.
Wild Fish Policy	Protect and enhance wild stocks.	No alternative would change habitat conditions enough in the short term on many already designated streams to protect existing stocks with certainty. In the long term, all alternatives would protect streams sufficiently to protect wild stocks and all but Alternatives NA, A, and B would provide sufficient stream habitat protection to contribute to their enhancement.

Consistency of the Proposed Action and Alternatives with State of Oregon Wildlife Plans (cont.)

State Plan/Statute	Objective	Consistency of Alternatives
Coho, Steelhead, and Trout Plans	Maintain and enhance production.	Similar to wild stocks. See preceding.
Basin Fish Management Plans	Establish compatible objectives for management of all fish stocks in each basin. Present tasks for attaining objectives, describe unacceptable management strategies and set priorities on achievement.	Similar to wild stocks. See preceding. Unacceptable management strategies defined mostly by omission.
Oregon Forest Practices Act Rules	Establish minimum standards which encourage and enhance the growing and harvesting of trees while considering and protecting other environmental resources such as air, water, soil, and wildlife.	See Appendix 4-22.

Appendix 4-22
Consistency of the Plan Alternatives with the Forestry Program for Oregon (FPFO)

FPFO Objective	Consistency of Alternatives
1. Forest Land Use. Preserve the forest land base of Oregon: Stabilize the present commercial forest land base. Manage habitat based on sound research data and the recognition that forests are dynamic and most forest uses are compatible over time.	All alternatives preserve most of the forest land administered by BLM, while allowing for some conversion of forest to accommodate expansion of transportation, power, and communication facilities. All alternatives also allow for exchange and/or sale of some forest lands, which could lead to their conversion to nonforest uses if local land-use plans permit. Land that would be managed for commercial forest products ranges from a high of 353,300 acres under alternative A to a low of 47,300 acres under alternative E. Only alternatives NA and A maintain at least the 331,600 acres currently allocated to commercial forest production. Alternatives C, D, and E allocate substantial acreage to management of habitats to the exclusion of timber production. The allocation of such land in alternative D is most explicitly based on current research data. The alternatives place varying stress on compatibility of forest uses.
2. Forest Practices. Assure practical forest practices that conserve and protect soil productivity and air and water quality: Promote forest practices that maintain Oregon's forest values, including forest tree species, fish and wildlife, soil productivity, and air and water quality. The Forest Practices Act and rules are one vehicle for accomplishing this.	All alternatives provide for the use of practical forest practices that meet this goal and, with some exceptions, meet or exceed the requirements of the Oregon Forest Practices Act and rules of the Oregon Smoke Management Plan. Specific exceptions are: inconsistency of alternative A with the snag/wildlife tree retention requirement and the scenic highway visual protection requirement of revised Section 5 of the Act; possible inconsistency of alternatives NA, A, B, and C with the rule requiring maintenance of 70 acres of suitable habitat encompassing each spotted owl nest site, and inconsistency of all alternatives except E with the 1991 interim rule regarding protection of intermittent streams that have a direct confluence with a Class I stream. Although the preferred alternative could be inconsistent with some FPA rules, the PA would be consistent with the objectives of the FPA. Since the 1991 interim rules are scheduled to be superseded by new rules by September 1, 1992, the preferred alternative for the proposed RMP/final EIS can be conformed to those new rules.

Appendix 4-22 (cont.)

FPFO Objective	Consistency of Alternatives
3. Timber Growth and Harvest. Promote the maximum level of sustainable timber growth and harvest on all forest lands available for timber production, consistent with applicable laws and regulations and taking into consideration landowner objectives.	Each alternative provides for the use of intensive forest management practices that are professionally and environmentally sound, to promote timber growth and harvest on all forest lands allocated as available for such intensive management, consistent with the alternatives' goals and objectives. Each alternative considers the application of such practices, even where they may be uneconomic, for the potential purpose of promoting timber growth and harvest.
4. Recreation, Fish and Wildlife, Grazing, and Other Forest Uses. Encourage appropriate opportunities for other forest uses, such as fish and wildlife habitat, grazing, recreation and scenic values on all forest lands, consistent with landowner objectives: A full range of recreation opportunities is encouraged. Where needed to reduce harassment and/or over harvest of wildlife, road closure programs are supported.	Each alternative provides opportunities for other forest uses, consistent with the alternatives' goals and objectives. Although all alternatives provide a full range of recreational opportunities, the emphasis of the alternatives varies. Alternative A limits the number of developed recreation sites maintained. Alternatives D and E emphasize nonmotorized recreation opportunities. Road closures to protect wildlife habitat and other values are emphasized in alternatives C, D, E, and the PA.
5. Forest Protection. Devise and use environmentally sound and economically efficient strategies to protect Oregon's forests from wildfire, insects, disease and other damaging agents: Use integrated pest management. Minimize total cost plus loss resulting from wildfire. Employ cost-effective fire management policies that emphasize planned ignition fires over natural ignition fires and that consider impacts to the state's forest fire protection program.	Under all alternatives, economically efficient protection strategies would be employed, and integrated pest management would be used. Minimizing total cost plus loss from wildfire would be integral. Planned-ignition prescribed fires would be emphasized over natural-ignition prescribed fires, but the latter could be used to achieve resource and fire management objectives. Cooperation with other fire suppression agencies, including state and local agencies, would help assure cost-effective fire protection and suppression by all parties. Alternatives D and E would provide less efficient protection from wildfire than the other alternatives, however, as their lower intensity of timber management in rural interface areas would increase both the risk of wildfire and the cost of suppression.

Appendix 4-23
Relationship of Alternatives to Statewide Planning Goals

Statewide Goal Number and Description	Consistency of Alternatives
1. Citizen Involvement - To develop a citizen involvement program that ensures the opportunity for citizens to be involved in all phases of the planning process. Federal and other agencies shall coordinate their planning efforts with the affected government bodies and make use of existing local citizen involvement programs established by cities and counties.	BLM's land use planning process provides for public input at various stages. Public input was specifically requested in developing issues, planning criteria, and the preferred alternative. Public input will continue to be utilized in development of the final RMP. Coordination with affected government bodies, including the Governor's forest planning team, has also been ongoing and will continue. BLM has used county planning departments to provide linkage to local citizen involvement programs.
2. Land Use Planning - To establish a land use process and policy framework as a basis for all decisions related to use of land and to assure an adequate factual base for such decisions and actions.	The preferred alternative and other alternatives have been developed in accordance with the land use planning process authorized by the Federal Land Policy and Management Act of 1976 which provides a policy framework for all decisions and actions. The process includes issue identification, inventories, and evaluation of alternative choices of action. Intergovernmental coordination in the planning process is discussed in Chapter 5 of the RMP/EIS.
3. Agricultural Lands - To preserve and maintain existing commercial agricultural lands for form use, consistent with existing and future needs for agricultural products, forest, and open space.	None of the alternatives exclude BLM-administered grazing land from grazing use or affect the use of other lands for agriculture use.
4. Forest Lands - To conserve forest lands for forest uses. Growing and harvesting of forest tree species is the leading use of forest land consistent with the sound management of soil, air, water, and fish and wildlife resources, and provision for recreational opportunities and agriculture.	BLM-administered lands in the planning area are predominately forest land and woodlands. None of the alternatives would lead to substantial conversion of those lands to nonforest uses. Conversion areas such as new forest roads and utility rights-of-way would be limited to the minimum width necessary for management and safety, and the latter limited to existing corridors where practical. All alternatives are consistent with the state's forest land protection policies.
5. Open Spaces, Scenic and Historic Areas, and Natural Resources - To conserve open space and protect natural and scenic resources. Programs shall be provided that will (1) ensure open space, (2) protect scenic and historic areas and natural resources for future generations, and (3) promote healthy and visually attractive	Natural, historic, and visual resources were considered in the development of the alternatives. Availability of mineral, aggregate, and energy sources would be greatest under the alternatives A, B and NA. Timber management under the alternatives would impact natural and visual resources. Adverse impacts to visual resources, wildlife habitat, potential wild and

Appendix 4-23 (cont.)

Statewide Goal Number and Description	Consistency of Alternatives

environments in harmony with the natural landscape character. The location, quality and quantity of the following resources shall be inventoried;

a. Land needed or desirable for open space;

b. Mineral and aggregate resources;

c. Energy sources;

d. Fish and wildlife areas and habitats;

e. Ecologically and scientifically significant natural areas, including desert areas;

f. Outstanding scenic views and sites;

g. Water areas, wetlands, watersheds and groundwater resources:

h. Wilderness areas;

i. Historic areas, sites, structures and objects;

j. Cultural areas;

k. Potential and approved Oregon recreation trails;

l. Potential and approved federal wild and scenic waterways and state scenic waterways.

Where no conflicting uses for such resources have been identified, such resources shall be managed so as to preserve their original character. Where conflicting uses have been identified, the economic, social, environmental, and energy consequences of the conflicting uses shall be determined and programs developed to achieve the goal.

Based on the analyses of economic, social, environmental, and energy consequences to Goal 5 resources listed above, conflicting uses of (BLM managed) lands and resources may be resolved by selection of three management options: (1) protect the resource site, (2) allow conflicting uses fully, or (3) limit conflicting uses. This is achieved by designating with certainty what uses and activities are allowed fully, what uses and activities are not allowed at all, which uses are allowed conditionally, and what specific standards or limitations are placed on the permitted and conditional uses and activities for each resource site.

scenic rivers and state waterways, and unique natural areas are greatest under alternatives A, B and NA, and least under alternative E. Water areas, wetlands, and watersheds would be protected under all alternatives, with the greatest protection under alternatives D and E. See Chapter 4 for discussions. Also see Appendix 4-22 for discussion of consistency with relevant sections of the Forest Practices Act and Rules. The PA attempts to balance conflicting uses in light of their consequences.

Under alternatives A, B and NA conflicting resource uses are generally resolved by allowing the (non-Goal 5) uses fully with minimal limitations in order to meet economic and certain social needs, except where clearly prohibited by federal or state law, in which case the non-Goal 5 use is limited to the extent necessary. Under alternatives D and E, conflicting resource uses are almost always resolved by protecting the (Goal 5) resource site or severely limiting conflicting uses to meet environmental and other social goals. Partial protection of (Goal 5) resources is most obvious in alternative C and the PA.

Even without any tradeoffs to enhance or maintain the existing commercial forest program, tradeoffs are necessary between Goal 5 resource values. For example, mineral and aggregate resource or energy source access and development frequently conflict with all other Goal 5 values, and strict guidelines for the management of designated or potential wilderness or federal wild rivers may virtually preclude development or active management to benefit other Goal 5 resource values.

Appendix 4-23 (cont.)

Statewide Goal Number and Description	Consistency of Alternatives
6. Air, Water, and Land Resources Quality - To maintain and improve the quality of the air, water, and land resources of the state.	The Federal and state water quality standards would be met and water quality would be maintained and/or improved under all alternatives. See Chapter 4, Effects on Water Resources, for discussion. Burning of logging slash under all alternatives would have a slight temporary effect on air quality at upper atmospheric levels. All alternatives would comply with the statewide Smoke Management Plan and the State Implementation Plan. See Chapter 4, Effects on Air Quality, for discussion. Also see Appendix 4-22 for discussion of consistency with relevant sections of the Forest Practices Act and rules.
7. Areas Subject to Natural Disasters and Hazards - To protect life and property from natural disasters and hazards.	Natural hazard areas, particularly floodplains and areas with highly erosive soils have been identified. All alternatives provide for appropriate management of natural hazard areas. Bureau authorized developments within natural hazard areas would be minimal under all alternatives, with project construction engineering reflecting site-specific conditions and requirements.
8. Recreational Needs - To satisfy the recreational needs of the citizens of the state and visitors and, where appropriate, to provide for the siting of necessary recreational facilities including destination resorts. Federal agency recreation plans shall be coordinated with local and regional recreational needs and plans.	The BLM actively coordinates its outdoor recreation and land use planning efforts with those of other agencies to establish integrated management objectives on a regional basis. Under all alternatives opportunities would be provided to meet recreation demand (identified in Oregon's SCORP). Projected demand for activities on BLM-administered land would be met with the following exceptions: alternatives D and E would not meet demand for off-road vehicle use; alternatives NA, A, B, and C would not meet demand for nonmotorized travel; and alternatives NA, A, B, and C would not meet demand for camping; alternatives NA, A, B, and C would not meet the demand for picnicking, studying nature, viewing wildlife; alternatives NA, A, B would not meet the demand for boating. See Chapter 4, Effects on Recreation, for further discussion. There has been no specific interest in development of destination resort sites on BLM-administered lands.

Appendix 4-23 (cont.)

Statewide Goal Number and Description	Consistency of Alternatives
9. Economy of the State - To diversity and improve the economy of the state.	Alternatives A, NA, and B would contribute to economic stability by supporting BLM-resource-dependent employment and payments to counties at levels near or above those of recent years. Alternatives C, D, E, and the preferred would support lower levels of such employment and payments to counties due to diminished timber production. Employment in rural areas would be most affected. See Chapter 4, Effects on Socioeconomic Conditions, for further discussion.
11. Public Facilities and Services - To plan, and develop a timely, orderly and efficient arrangement of public facilities and services to serve as a framework for urban and rural development.	Under all alternatives, BLM-administered lands may be made available for development of public facilities or services by other parties, if the action would be permitted under the local government comprehensive plan and land use regulations, and relevant state siting requirements. Under alternatives A and B, however, commercial timberland might not be made available for such uses.
12. Transportation - To provide and encourage a safe, convenient, and economical transportation system.	All alternatives provide for accommodation of identified transportation needs, particularly for transportation of timber, but siting a major new transportation route (e.g., state highway) would require a plan amendment. Major utility corridors were considered and would be designated under all alternatives. The alternatives support state policy objectives to restrict use of BLM roads for access to non-resource development that would be inconsistent with state planning goals.
13. Energy Conservation - To conserve energy.	Conservation and efficient use of energy sources are objectives in all BLM activities. Only alternative E proposes inclusion of some additional rivers in the National Wild and Scenic River System, which would restrict the possibility of development of their hydroelectric potential, there are no pending development proposals and those rivers are considered to have low potential for such use. Firewood sales would be permitted under all alternatives, but under Alternatives C, D and E, firewood availability would be limited by retention of wood on site to provide wildlife habitat and help maintain soil productivity, and by allocation of substantial acreage to limited or no timber harvest.

Statewide goals: 10. Housing; 14. Urbanization; 15. Willamette River Greenway; 16. Estuarine Resources; 17. Coastal Shorelands; 18. Beaches and Dunes; and 19. Ocean Resources are not applicable to Roseburg District BLM Planning Area.

Appendix 4 -24 Timber Supply Analysis For BLM Planning

The purpose of this analysis is to report regional stumpage price[1], timber harvest on all ownerships, and log consumption within geographically defined subregions (figure 1) resulting from implementing each of the five common resource management plan alternatives, as well as the preferred alternatives, on all U. S. Department of the Interior Bureau of Land Management (BLM) Districts in western Oregon. The analysis covers a period of initial plan implementation (1993-2000)[2] and the period thereafter (2001-2010). The baseline period that provides a historical benchmark for comparison was 1984-1988.

The purposes of this appendix are to: summarize key concepts used to conduct the analysis, provide a description of the procedures used, and briefly compare the analysis results to the baseline period and an earlier outlook of western Oregon timber supply (Sessions 1990). Results appear in chapter 4 of the RMP/EIS describing the effects of alternatives. Specifically, the regional stumpage price results were used to calculate an index of BLM stumpage price changes (relative to the 1984-1988 baseline price). These price changes were then used in the assessment of personal income and employment effects. Harvest and log consumption results are presented in the timber supply tables of chapter 4.

Key Concepts

Implemented on all Districts, each set of similar resource management plan alternatives represented a different timber supply policy, or alternative theme, for BLM administered lands in western Oregon. The question being addressed by this analysis is how do changes in BLM timber supply policy affect how much timber is harvested and consumed in subregions of western Oregon? The subregions in figure 1 were explicitly interdependent through the transfer of logs from one subregion to another. The importance of subregions was in their partitioning of western Oregon into areas that differed in ownership distribution, private timber availability, and silvicultural management, while at the same time serving as logical reporting areas for western Oregon BLM Districts (see table 1).

[1]Definitions for terms such as regional stumpage price can be found in the terminology section following the main text.

[2]Actual data was completed through the end of 1990. Analysis results covering the 1991-2000 period were converted to an annual basis and reported for the 1993-2000 period since the BLM resource management plan implementation was assumed not to commence prior to 1993.

This analysis recognized that the BLM is just one timber supplier within western Oregon and that the impact of harvest changes is felt where the timber is actually consumed. Furthermore, any measure of the timber harvest and related consumption consequences of BLM actions must account for how the private land ownership reacts to changes in BLM timber supply policy. The amount of timber offered for sale by the BLM affects stumpage prices and these effects influence the decision of private forestland owners to harvest their timber. The result is an inverse relationship between the amount of BLM timber offered and the amount of private timber harvest.

The amount of timber demanded by processing mills is inversely related to stumpage prices. Timber demand is determined by factors outside the control of the BLM or any other forest land ownership category, such as end use consumption in the national economy (for example, the number of new homes being built) and other national economic variables like gross domestic product and the interest rate. Poor demand years result in low levels of consumption and low product prices; good years feature the same level of consumption under higher product prices. For the purpose of this analysis, year to year fluctuations in timber demand were averaged over a 10 year analysis period.

Timber supply is determined by ownership, subregional location, and stand condition. Ownership determines the policy specifying the conditions under which the timber may be harvested. Subregional location accounts for variations in species composition and the amount of timber available for harvest. Stand condition measures the amount of harvestable volume available on a per acre basis, as well as the growth rate and stage of development of this volume. Private timber supply is directly proportional to stumpage prices. This analysis accounted for changes in private timber supply by assessing inventory conditions at the beginning of each analysis period. For public agencies such as the USDA Forest Service and the BLM, timber supply is fixed at the planned allowable sale quantity; regardless of the stumpage price (down to a minimum acceptable bid), the same amount of timber would be harvested over the analysis period.

Market equilibrium defines a balance between timber supply and demand: the amount of timber harvested equals the amount of timber consumed and one stumpage price governs the exchange between suppliers and demanders. Implementing a new BLM timber policy will disrupt this balance and leads to

adjustments in the stumpage price such that a new timber supply and demand balance is created. In this analysis, market equilibrium is explicitly recognized for the Pacific Northwest - westside region, and this implies a local equilibrium within western Oregon subregions.

Procedure

The procedures used for the 1991-2000 period were: solving regional market equilibrium, disaggregation of the regional private harvest, displaying the timber harvest by ownership, and reapportioning the timber harvest as log consumption by processing facilities. Log exports from private and other public lands to foreign destinations was treated as domestic log consumption at the port of export.

In contrast, the procedures used over the 2001-2010 period were not dependent on a regional market equilibrium solution; rather the private harvest projections reflected the same behavioral response to the implemented resource management plans determined for the 1991-2000 period. This allowed the analysis to focus on whether the private inventory would provide a lower, same, or higher harvest over 2001-2010 when compared to the estimated 1991-2000 harvest.

Solving Regional Market Equilibrium; 1991-2000

This step determined the market adjustments, and associated regional stumpage price, that would result if a given set of resource management plan alternatives were implemented on BLM administered lands in western Oregon. The Timber Assessment Market Model (TAMM) (Adams and Haynes 1980, Haynes and Adams 1985, and Haynes 1990) was used to calculate the new regional stumpage price balancing timber supply and demand. The Timber Assessment Market Model was ideal for this kind of analysis since the model provided 50 year projections of consumption, production, and prices of forest products and stumpage under an array of externally specified conditions on policy and the economic environment surrounding the forest sector. The model is national is scope and is divided into 11 supply regions and 5 demand regions. Solution is in the form of a spatial supply and demand balance amongst regions. Therefore, the market equilibrium for the Pacific Northwest - westside region was dependent in part on what is happening in other regions of the U. S. Overall, the quantities produced and their distribution to demand regions is based on the maximization of producer profits net of transfer costs in each supply region.

The external policy condition that was changed for each TAMM run was the BLM sawtimber sale quantity resulting from holding each District in western Oregon at similar resource management plan alternatives. Four TAMM runs were made, each with a different resource management plan theme: current plans (i.e., no action), alternative A, alternative C, and the preferred alternative. Implementation of BLM resource management plans was assumed to commence in 1993. In order to reflect actual conditions since 1990, reported and estimated BLM sawtimber harvest quantities were used in 1991 and 1992 for all four runs. Similarly for 1991 National Forest harvest quantities. The National Forest sawtimber sale quantities for Pacific Northwest - westside forests in 1992 and beyond reflected planned offerings under the USDA Forest Service Spotted Owl Final Environmental Impact Statement, record of decision in March 1992 (U. S. Department of Agriculture 1992a and 1992b).

The key outputs for each TAMM run were the regional price and the total (hardwood and softwood) private growing stock removals for the Pacific Northwest - westside (PNWW) region. Growing stock removal was the relevant output because it represented the portion of total harvest that comes from the private inventory[3]. Annual removals from the industrial and other private ownership classes in TAMM (softwood and har&dwood volume combined) were summed to estimate the total private removal over the 1991-2000 period. The western Oregon share of the 1991-2000 PNWW total harvest was taken to be 0.4466, the historical 1971-1990 average of western Oregon's proportion of the total Pacific Northwest - westside private harvest (figure 2).

In summary, the regional market equilibrium solution resulted in a Pacific Northwest - westside regional stumpage price and western Oregon's share of the corresponding private growing stock removals, given a set of similar resource management plan alternatives assumed implemented on BLM administered lands in western Oregon. Table 2 contains the results of the regional market equilibrium for each resource management plan theme. Results for alternatives B, D, and E were interpolations of the results of the TAMM runs for alternatives, A, C, current plans, and preferred.

Disaggregation of the Private Harvest; 1991-2000

The disaggregation of the private harvest into western Oregon subregions used Connaughton and Campbell's

[3]Other harvest sources are from forestland conversions to other uses and dead and down large material.

(1991) probability of stand harvest model. Throughout most of western Oregon, the regeneration harvest type was clearcut, the exception being the Medford subregion where the harvest was either clear cut or partial cut depending on even-aged or uneven-aged stand management. Commercial thinning treatments, if appropriate, were applied to non-regeneration harvest acres. Volumes removed from thinning contributed to the disaggregation of western Oregon's share of the TAMM private harvest.

The application of Connaughton and Campbell's (1991) model required: an updated 1990 year-end inventory, stand growth and yield projections for all private lands, and calibration for changes in federal timber policy on National Forests that occurred subsequent to the 1976-1984 period of estimation for Connaughton and Campbell's model. The calibration procedure resulted in a mechanism for adjusting the probability of stand harvest for different BLM timber supply policies. Given the same stand conditions, the higher the regional stumpage price under the BLM policy, the greater the probability of stand harvest.

Inventory and Growth Projections for Private Timberlands

The growth and yield of western Oregon's private forests were simulated by projecting future stand conditions on each of 789 field plots measured by personnel from the Pacific Northwest Research Station in 1984 and 1985, and reported in Gedney and others (1986a), (1986b), and 1987). The plots are laid out over western Oregon in a systematic grid, and each represents a specific number of acres (plot expansion factor) determined by its subregional location and ownership. The sum of the expansion factors for all projected plots in western Oregon was 5,864,163 acres. All plots were capable of producing at least 20 cubic feet per acre per year of wood suitable for log consumption and were not reserved for purposes precluding timber harvest.

Most field plots are composed of five sample points distributed over five acres, with observations on tree species, diameter, and height recorded for each point. The stands on each point were separately projected and then summed to represent forest condition for the plot. Some plots had either very young stands with no measurable volume or were yet to be regenerated, and these were projected as if a uniform number of trees of a typical species mix and number of seedlings were present on each point.

Two stand simulators were used to project the stand conditions for each inventory plot: the Stand Projection System (SPS), Version 2.3a (revised 8/1/91; Arney 1985), and the Oregon Growth Analysis and Projection System (ORGANON), Version 3.0 (Hester et al 1989). The Stand Projection System was used for plots located in all subregions except Medford and Roseburg; ORGANON was used in the latter two subregions.

Silvicultural management regimes, which are a set of activities to be carried out as the stand develops, were assigned to each plot. The regimes varied by stage of stand development (young stands, established stands) and location. Table 3 lists and summarizes the regimes, and shows the total number of acres represented by the plots assigned to each regime. The 1991-2000 disaggregation, and the 2001-2010 projection, of the private timber harvest were not heavily influenced by any management activity other than harvesting itself. Commercial thinning and fertilization both had minor effects on the results: the former because it contributed to harvest and altered stand development; the latter because it accelerated growth.

Stand conditions were updated to 1990 for land use changes and harvesting that had occurred since the plots were measured in the mid-1980's. Photo-interpretation, field checks, and county tax assessment records were used to conduct the update. Growth between the mid-1980's and 1990 was projected using either SPS or ORGANON, depending on the subregion in which the plot was located.

Calibration for Changes in Federal Timber Policies

The variables determining Connaughton and Campbell's (1991) probability of stand harvest model are the anticipated compound growth rate for the stand and the stand's growing stock volume. Both of these variables are structured as a function of the time interval within which the probability of stand harvest applies. For example, Connaughton and Campbell's model was estimated using two successive inventories; the first representing 1976 conditions, the second 1985 conditions. The logic behind Connaughton and Campbell's model is to think of a private forest landowner viewing a stand in 1976 where the stand's growing stock volume is known. The 1976 to 1985 compound growth rate becomes a surrogate for the owner's anticipated growth rate for the stand over the next 10 years.

Since the model was actually estimated for a 9 year interval (1976-1984), the estimated probability of stand harvest represents the likelihood that the owner would harvest the stand sometime during the interval. Given that the plot represents numerous like stands; the estimated probability can be thought of the proportion

of area represented by the plot that would actually be harvested within the next 9 years[4]. For each subregion, the total private harvest was computed as:

$$\text{Total Private Harvest} = \Sigma_k (P_k V_k A_k) \qquad (1)$$

where:

P_k is the estimated probability of stand harvest (a value between 0 and 1 inclusive) for the subregion's kth plot.

V_k is the volume per acre of material available for harvest for the subregion's kth plot.

A_k is the area expansion factor (acres) for the subregion's kth plot.

The private harvest was further distinguished by industrial versus non-industrial ownership.

In western Oregon, public timber supply levels are large enough that changes in offerings from National Forests or the BLM will influence stumpage price. Therefore, the estimated probabilities using the reported coefficients in Connaughton and Campbell's (1991) model imply private harvesting behavior consistent with the federal policies in effect over 1976-1984 period. Given that the model was to be applied using the 1990 growing stock and the anticipated growth rate for the 1991-2000 period[5], their reported model coefficients had to be adjusted to reflect changes in National Forest timber supply policies since the 1976-1984 period. The simplest approach was to adjust the intercept term in Connaughton and Campbell's model for assumed changes in the private harvest behavior under different federal timber supply policies. This was done by iteratively solving for the new intercept term value for Connaughton and Campbell's model such that the computed probabilities, when applied to the total private harvest formula in (1) for all subregions, would result in western Oregon's share of the TAMM private harvest for the federal policy under investigation.

For example, western Oregon's share of the TAMM projected private timber harvest for the Pacific Northwest - westside region under a federal timber supply policy reflecting new National Forest plans (*circa* 1990) and the BLM under current plans adopted in the 1980's[6] is 668 million cubic feet per year (mmcf/year). In contrast, directly applying the estimated coefficients in Connaughton and Campbell's (1991) model to the updated 1990 inventory resulted in an independent 1991-2000 private harvest projection for western Oregon of 663 mmcf/year. The 663 mmcf/year projection represents an extrapolation of the 1976-1984 private harvest behavior to the 1991-2000 period. The question then becomes: What intercept term in Connaughton and Campbell's probability of stand harvest model, when applied to the 1990 stand conditions, would give probabilities that result in a private harvest calculation from the formula in 1 equal to the TAMM derived western Oregon private harvest of 668 mmcf/year?

Figure 3 summarizes the results of the calibration procedures. The regional stumpage price serves as an indicator of the regional market equilibrium for the federal timber supply policy assumed in effect over the 1991-2000 period. In general, the private harvest does not vary too much as a result of significant price differences associated with the various federal timber supply policies represented. Therefore, only minor adjustments to the intercept term in Connaughton and Campbell's (1991) model were necessary for the private harvest disaggregation. The closeness of the Connaughton and Campbell, and the TAMM National Forest (before new plans), results in figure 3 reflect that both projections assume a similar National Forest timber supply policy for the 1991-2000 period; namely timber sale offerings at the level existing over the 1976-1984 period.

Displaying the Timber Harvest by Ownership; 1991-2000

Five ownership groups were used to portray the timber harvest outlook, by subregion, for each BLM resource management plan theme considered: the BLM, National Forests, other public, non-industrial private, and industrial private. For all BLM alternatives, the National Forest harvest levels were held constant at the allowable sale quantity for the preferred alternative in the Final Environmental Impact Statement for the northern spotted owl (table 4). National Forest and BLM allowable sale quantities were pro-rationed to western Oregon subregions using the administrative

[4]In application, the 9 year area proportions were extrapolated to reflect harvested acreage over a 10 year period.

[5]The anticipated growth rate was calculated as the compound growth rate bringing the 1990 stand growing stock volume to its year-end 2000 counterpart in the absence of any scheduled thinning. The rationale applied here was that the owner's anticipated growth rate, for the purposes of identifying candidate stands for final harvest, would not be based on the stand being thinned over the period as well.

[6]Timber Assessment Market Model (TAMM90), log run 529.

area harvest pro-rationing factors used in Greber and others (1990). The other public harvest was also held constant at the observed 1984-1988 annual average for all BLM resource management plan alternatives.

Changes in the harvest by BLM resource management plan theme were due to differing BLM allowable sale quantities across alternatives, and the unique private harvest response to each BLM resource management plan theme considered. As discussed above, the private harvest disaggregation, by subregion, was based on a 10 year accumulation of the annual TAMM projections over the 1991-2000 period and then converted to an annual harvest rate for the period. While only labelled as occurring over the 1993-2000 period, the annual private harvest actually reflects the 1991-2000 rate of harvest which included 2 years (1991 and 1992) of same BLM harvest quantity for all BLM alternatives considered since plan implementation was assumed to commence in 1993.

Reapportioning the Harvest into Log Consumption; 1991-2000

The consumption of harvested timber by processing facilities within western Oregon was calculated using an average of the 1982 log flow information reported in Howard (1984a) and the 1988 log flow information reported in Howard and Ward (1991a). These two years contrasted periods of differing economic activity; the recession in 1982 and the recovery in 1988. Both the 1982 and 1988 log flows were adjusted for the amount of western Oregon timber processed out-of-state using Howard (1984b), Howard and Ward (1991b), Larsen and others (1983) and Larsen 1992). The data was expressed as fractions representing the proportion of timber harvested in one subregion processed in other subregions (including itself).

Log consumption was calculated as follows:

$$\mathbf{q} = \mathbf{h} \cdot \mathbf{LOGFLOW}. \qquad (2)$$

where:

q denotes a vector of log consumption, where q_i represents the amount of log consumption by processing facilities located in subregion i.

LOGFLOW denotes a matrix of log flow proportions containing elements α_{ij} representing the proportion of timber harvested within subregion i processed in subregion j; where $\Sigma_j \alpha_{ij} = 1$.

h denotes a vector of timber harvest, where h_i represents the total harvest from all ownerships in subregion i.

Updating the Private Inventory; Harvest and Log Consumption 2001-2010

Acres harvested for regeneration over the 1991-2000 period were removed from the inventory and unavailable for harvest during the 2001-2010 period. Thinned acres, plus non-harvested acres not scheduled for thinning, became the acres available for harvest over the 2001-2010 period. These acres were paired with year-end 2000 yields, mid-period 2005 harvest and thinning yields (if appropriate), and year-end 2010 yields (in the absence of thinning) for application of the Connaughton and Campbell (1991) probability of stand harvest model over the 2001-2010 period.

No further adjustments to the intercept term in Connaughton and Campbell's model were made for the 2001-2010 harvest projections. The rationale was a continuation of the resource management plans assumed implemented during the 1991-2000 period. Holding the intercept term constant indicated no further change in private harvesting behavior. What did change though was the available private harvest inventory that this behavior would apply to. That is, given the change in the composition of the private inventory resulting from growth and harvest removals over the 1991-2000 period, what quantity of private harvest would occur over the 2001-2010 period using the same intercept term in Connaughton and Campbell's model used in the 1991-2000 harvest projection? Differences in the private harvest projections for the 2001-2010 period, when compared to the 1991-2000 period, reflected harvest increases (or decreases) associated with the characteristics of the year-end 2000 inventory when compared to the year-end 1990 inventory.

The procedures used to display the timber harvest and log consumption for the 1991-2000 period were the same ones used for the 2000-2010 period. The harvest quantities for the BLM, National Forests, and other public ownerships were the same as reported for the 1991-2000 period. Therefore, the aggregate annual harvest total for 2001-2010, when compared to the 1991-2000 annual total, solely reflected differences in the private harvest.

What About the Klamath Resource Area of the Lakeview District?

The Bureau of Land Management's Klamath Resource Area administered by the Lakeview District is located outside boundaries used for this analysis. Therefore, private harvest responses to differing BLM allowable sale quantities by resource management plan alternative in the vicinity of the Klamath Resource Area

(Klamath County) were not provided by this analysis. However, some effects attributable to the Klamath Resource Area were still captured by the analysis.

The TAMM regional market equilibriums did include the Klamath Resource Area allowable sale quantities as BLM harvest volume originating within the Pacific Northwest - westside region; though technically the Klamath Resource Area is located on the eastern slope of the Cascade Range. This is reasonable since there is observed log flow from Klamath County into western Oregon counties. From a regional perspective it made more sense to lump the Klamath Resource Area as part of the total BLM effect on the Pacific Northwest - westside region rather than splinter out its small allowable sale quantity and model its regional impact on TAMM's Pacific Northwest eastern supply region. Finally, how differing allowable sale quantities by resource management plan alternative on the Klamath Resource Area effected western Oregon log consumption was provided by the analysis.

Results and Discussion

Table 5 summarizes the private harvest disaggregation for the 1991-2000 period and subsequent projections for the 2001-2010 period. Furthermore, table 5 compares these results to the 1984-1988 historical baseline, as well as earlier timber availability projections contained in Sessions (1990). There is little response in the western Oregon private harvest across BLM resource management plan themes since the stumpage price - private harvest response relationship in TAMM is inelastic (see table 2 and figure 3). For western Oregon as a whole, the private harvest projections vary across BLM resource management plan themes by 15-20 million cubic feet per year (table 5). This variation is even narrower (8-10 million cubic feet per year) for the 2001-2010 period.

When compared to the 1984-1988 baseline period, the 1991-2000 private harvest disaggregation, regardless of BLM resource management plan theme, exceed the 1984-1988 baseline harvest by 100 million cubic feet per year. The increase during the 1991-2000 period reflects a private harvest response to the regional stumpage price increase that occurred between the 1984-1988 period and the 1991-2000 projection period (table 2) as a result of the reduced timber supply offerings on National Forest lands. Furthermore, these harvest increases can be attributed to increases on the non-industrial private ownership since the 1991-2000 harvest disaggregation of the industrial ownership is lower than the 1984-1988 historical baseline (table 5). The proportion of private timberland harvested over the 1991-2000 period to the total private timberland acreage available at the end of 1990, ranged from 13 to 18 percent across subregions (higher percentages to the north) and was not substantially affected by the BLM resource management plan theme being considered. Thinned acres represented 2 to 9 percent of the area of private timberland existing in 1990.

Comparison of the 2001-2010 projections with the 1991-2000 harvest disaggregation shows a dramatic increase in the total private harvest, roughly 100 million cubic feet per year (table 5). This holds for all subregions except the South Coast and Medford. The increase reflects that young, fast-growing stands, not harvested over the 1991-2000 period become attractive for harvest (in the context of the landowner behavior in Connaughton and Campbell's (1991) probability of stand harvest model) in the 2001-2010 period. One important qualification for this harvest gain is that pre-1990 forest practice rules and related environmental constraints on the private timberlands remain unchanged through 2010. The proportion of private timberland harvested over the 2001-2010 period to the total private timberland acreage available at the end of 2000, ranged from 15 to 23 percent across subregions (higher percentage to the north). The proportion of private timberland area thinned ranged from 4 to 10 percent of the total private timberland acreage not harvested by 2000.

The timber availability projections in Sessions (1990), which contained no mechanism for adjusting private harvest quantities to stumpage prices, would underestimate the private harvest disaggregation for the 1991-2000 period. In addition, the Sessions' private harvest projections for periods subsequent to the year 2000 were constrained by an even flow condition. In contrast, the 2001-2010 harvest projections from this analysis reflect the flexibility of the private ownership to harvest within all available merchantable age classes without any restrictions regarding even flow. In all likelihood, the 2001-2010 harvest quantities in this analysis would exceed the Sessions' even flow requirement.

Table 6 summarizes the log consumption results by BLM resource management plan theme for the 1993-2000 and 2001-2010 reporting periods. For comparison purposes, the total western Oregon harvest from all ownerships is shown. Western Oregon was a net importer of logs over the 1984-1988 period as total consumption exceeds harvest (table 6). This pattern was not allowed to vary in this analysis. Since log consumption was a reapportioning of the timber harvest to where the volume is consumed, differences across BLM resource management plan alternatives

were minor and reflected the inelastic private timber harvest response to the different BLM allowable sale quantities.

For all BLM resource management plan themes, log consumption in western Oregon is projected to decrease when compared to the 1984-1988 baseline period. Most of this decrease is from reduced National Forest allowable timber sale quantities. The loss in consumption would have been greater had it not been for harvest increases on private lands; especially the non-industrial ownership (table 5). By the 2001-2010 period, further increases in both the industrial and non-industrial private harvest brings consumption close to historical levels. In addition, implementing alternatives A or B on all BLM administered lands in western Oregon would provide enough harvest to restore consumption to the 1984-88 historical level (table 6).

Terminology

Allowable Sale Quantity — Planned timber sale offerings from federal lands. For the USDA Forest Service, refers to offered quantities of sawtimber convertible to lumber or plywood. For the BLM, includes sawtimber and a small component of sound chippable material.

Analysis Period — Computation periods for the analysis. Period 1 covers the period of plan implementation (1991-2000) and period 2 covers the first period thereafter (2001-2010). Results for the 1991-2000 period are converted to an annual basis and reported for the 1993-2000 period since BLM resource management plan implementation was assumed to commence in 1993.

Baseline Period — Historical period used as a reference point for comparison of projected harvests. The period chosen by the BLM was the 1984-1988 period (U. S. Department of the Interior 1988).

BLM — U. S. Department of the Interior, Bureau of Land Management, Districts of western Oregon: Coos Bay, Eugene, Medford, Roseburg, Salem, and the Klamath Falls Resource Area of the Lakeview District.

Commercial Thinning — Removal of industrial crop trees to reduce competition among remaining trees in the stand, and thereby increase growth and yield of remaining trees. For purposes of growth and yield projections, assumed to occur during the fourth decade of stand development on slopes less than 35% slope (40-45% in the Medford subregion). Minimum volume and basal area restrictions were also applied in the Medford subregion to more realistically portray commercial thinning.

Fertilization — Application of nitrogen fertilizer to forest land to increase the rate of tree growth. For the projection of growth and yield, fertilization was assumed to be applied at a rate of 200 lbs/acre for eligible plots. Eligible plots were those of medium site productivity on the industrial ownership in all subregions except Medford. Application was assumed to occur during the third decade of stand development when preceding commercial thinning, and the fifth decade of stand development when preceding clearcut.

Log consumption — Volume of timber processed by manufacturing and export facilities throughout western Oregon. Calculated as a reapportioning of the western Oregon timber harvest using log flow information in Howard (1984a) and Howard and Ward (1991a). Also includes timber processed from eastern Oregon and out-of-state origins. Manufacturing includes primary end-uses such as lumber, plywood, and other products using sound chippable material. Includes logs exported to foreign destinations from western Oregon ports.

National Forests — Western Oregon National Forests of the USDA Forest Service Pacific Northwest Region: Mt. Hood, Rogue River, Siskiyou, Siuslaw, Umpqua, and Willamette.

Ownership, Owner Groups — See definition of timber harvest below.

Pacific Northwest - Westside (PNWW) Region — That portion of Oregon and Washington west of the Cascade Range divide.

Pre-commercial Thinning — Removal of young trees with no commercial value to provide growing space for future crop trees. For the projection of growth and yield, pre-commercial thinning was assumed to occur early in second decade of stand development when 60% or more of the plot's points had a stocking of more than 350 conifers per acre; lower stocking levels were permissible for the Medford subregion. Approximately 275 trees per acre were projected to remain after pre-commercial thinning.

Private Timberland — Private forestland capable of producing 20 cubic feet per acre per year of wood suitable for log consumption and were not reserved for purposes precluding timber harvest.

Probability of Stand Harvest — Refers to the likelihood that a inventory plot (representing a stand), given its growing stock volume of harvestable material and anticipate growth, will be harvested within a 10 year period. These probabilities were estimated by adjust-

ing Connaughton and Campbell's (1991) probability of stand harvest model for different federal timber supply policies. Each probability represents the proportion of plot's area expansion harvested over the 10 year period.

Regional Market Equilibrium - A balance between the quantity of timber supplied with the quantity of timber demanded (including volume exported for out-of-region consumption) for the Pacific Northwest - westside region. The quantity of timber supplied is reported as timber harvest, while the quantity of timber demanded is reported as log consumption.

Regional Stumpage Price — The market clearing regional stumpage price (in 1967 dollars per thousand board feet) that balances timber supply and demand for the Pacific Northwest - westside region. The average value of all species of timber harvested from USDA Forest Service National Forest lands in the Pacific Northwest - westside region was used as a proxy for the regional stumpage price. See Warren 1992; deflated to 1967 dollars per thousand board feet, Scribner. using the producer price index, all commodities (1967=100) reported in Ulrich (1988) and (1990).

Resource Management Plan Theme — Refers to the implementation of similar resource management plan alternatives on all BLM administered lands in western Oregon. The themes correspond to Alternatives A-E, current plans, and the Preferred alternative.

Stand Conditions — Refers to the per acre quantity (million cubic feet) of harvestable material on an inventory plot, or stand represented by an inventory plot. Also includes the compound rate growth over a specified 10 year period.

Subregion — Geographically defined reporting areas for timber supply and log consumption. They are defined to closely approximate the local areas proximate to BLM District boundaries. See figure 1 and table 1.

Timber Assessment Market Model (TAMM) — A supply and demand equilibrium model that provides 50 year projections of consumption, production, and prices of forest products and stumpage under an array of externally specified conditions on policy and the economic environment surrounding the forest sector (see Adams and Haynes 1980, Haynes and Adams 1985, and Haynes 1990).

Timber Demand — An inverse stumpage price - quantity relationship for logs. Timber demand is determined by factors outside the control of the BLM or any other forest land ownership category. This analysis accounts for timber demand in the regional market equilibriums calculated using the Timber Assessment Market Model.

Timber Harvest — Timber harvest is distinct from timber supply in that harvest represents tree volume removed from growing stock inventory and converted into primary end uses such as lumber, plywood, and other products using sound chippable material. Reported on an annual basis. Definitions by ownership groups are as follows:

Source of Change

<u>BLM</u> - USDI Bureau of Land Management planned 10 year allowable sale quantity for the Coos Bay, Eugene, Medford, Roseburg, and Salem Districts; and the Klamath Resource Area of the Lakeview District. Varies by resource management plan theme. Includes sawtimber and sound chippable material.

Estimated by the Analysis

<u>Industrial</u> - Ownership class of private lands owned by companies or individuals operating wood using plants. Also includes large corporate owners who manage lands for timber production but do not own or operate wood using plants. Harvest refers to net merchantable growing stock removals.

<u>Non-Industrial Private</u> - Ownership of private lands that does not meet the industrial classification. Includes small woodland owners and farmers. Harvest refers to net merchantable growing stock removals.

Held Constant Across all BLM Resource Management Plan Themes

<u>National Forest</u> - USDA Forest Service planned 10 year allowable sale quantity for Oregon National Forests west of the Cascade Range Divide (see table 4). This quantity only includes sawtimber material suitable for lumber or plywood manufacture.

<u>Other Public</u> - Observed 1984-1988 timber harvest from local, state, and federal (excluding BLM and National Forest) timberlands.

Timber Supply — Timber supply is a schedule of what quantity of trees may be removed given ownership policies, available inventory, and stumpage price. Timber harvest is an observable consequence of timber supply. Public forest owners were assumed to

have an inelastic timber supply schedule not responsive to stumpage price.

USDA Forest Service — U. S. Department of Agriculture, Forest Service.

Supporting Data

Actual 1991 and 1992 BLM Harvest — Used to initialize the TAMM projections for the actual level of BLM timber harvest for the first two years of the 1991-2000 analysis period. The 1992 harvest is an extrapolation of the observed harvest through March 1992. ***Source:*** USDI Bureau of Land Management, Portland, Oregon.

BLM Allowable Sale Quantities — Planned allowable sale quantities by western Oregon District for each resource management plan theme. ***Source:*** USDI Bureau of Land Management, Portland, Oregon.

BLM Chip Proportions — Proportion of BLM allowable sale quantity in sound chippable material. Used to convert reported BLM allowable sale quantities into sawtimber component since it is the sawtimber component that is necessary for input into TAMM. ***Source:*** USDI Bureau of Land Management, Portland, Oregon.

Exogenous Consumption — Logflow from the following county origins and processed within western Oregon subregions were held constant throughout the analysis: 1) Klamath county origin, 2) Other eastern Oregon counties, and 3) Out-of-State county origin. Annual volumes were the average of the 1982 and 1988 reported log flows from these origins into western Oregon. ***Source:*** Howard 1984a, Howard and Franklin 1991a.

Log Flows — Used to calculate log flow proportions used in log consumption calculations. ***Source:*** Larsen and others (1983), Howard (1984a), Howard (1984b), Howard and Ward (1991a), Howard and Ward (1991b), and Larsen (1992).

National Forest Allowable Sale Quantities — USDA Forest Service planned 10 year allowable sale quantity in million cubic feet per year. This quantity only includes sawtimber material suitable for lumber or plywood manufacture. This sale quantity assumes implementation of the Interagency Scientific Committee's conservation strategy for the northern spotted owl as indicated in the Final Environmental Impact Statement for the northern spotted owl (U. S. Department of Agriculture 1992a and 1992b). See table 4. ***Source:*** USDA Forest Service, Pacific Northwest Region, Portland, Oregon.

National Forest and BLM District Administrative Area Harvest Pro-rationing Factors — Represents the proportion of allowable sale quantity from an administrative unit (e.g., National Forest, BLM District) occurring within the boundaries of a particular subregion. ***Source:*** Adapted from supplemental information used in Greber and others (1990).

Other Public Harvest — Annual average for the 1984-1988 period as reported in the Oregon timber harvest reports (Oregon Forestry [1986], Oregon State Department of Forestry [1985, 1987], Oregon State Forestry Dept. [1988, 1989]). Converted to million cubic feet per year.

Literature Cited

Arney, James. D. 1985. A modeling strategy for the growth projection of managed stands. Canadian Journal of Forest Research 15: 511-518.

Adams, D. M., and Haynes, R. W. 1980. The 1980 Softwood timber assessment market model: structure, projections, and policy simulations. Forest Science Monograph No. 22. 62 p.

Connaughton, Kent P. and Campbell, C. Duncan. 1991. Comparing industrial and nonindustrial harvesting behavior: a probabilistic approach. P. 342-347 *in* Proceedings of the 1991 symposium on systems analysis in forest resources. March 3-6, Charleston, South Carolina. Buford, Marilyn A. Compiler. General Technical Report SE-74. Ashville, North Carolina: U. S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 423 p.

Gedney, Donald R., Bassett, Patricia M., and Mei, Mary A. 1986a. Timber resource statistics for non-federal forest land in southwest Oregon. Resource Bulletin PNW-138. Portland, Oregon: U. S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 26 p.

Gedney, Donald R., Bassett, Patricia M., and Mei, Mary A. 1986b. Timber resource statistics for non-federal forest land in northwest Oregon. Resource Bulletin PNW-RB-140. Portland, Oregon: U. S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 26 p.

Gedney, Donald R., Bassett, Patricia M., and Mei, Mary A. 1987. Timber resource statistics for non-federal forest land in west-central Oregon. Resource Bulletin PNW-RB-140. Portland, Oregon: U. S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 26 p.

Greber, Brian J.; Johnson, K. Norman; Lettman, Gary. 1990. Conservation plans for the northern spotted owl and other forest management proposals in Oregon. The economics of changing timber availability. Papers in Forest Policy 1. Corvallis, OR. Oregon State University, College of Forestry, Forest Research Laboratory. 50 p.

Haynes, R. W., and Adams, D. M. 1985. Simulations of the effects of alternative assumptions on demand-supply determinants on the timber situation in the United States. Forest Resources Economics Research. Washington DC: U. S. Department of Agriculture, Forest Service. 113 p.

Haynes, R. W. Coordinator. 1990. An analysis of the timber situation in the United States: 1989-2040. General Technical Report RM-199. Ft. Collins, Colorado: U. S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 286 p.

Hester, Arlene S., Hann, David W., and Larsen, David R. 1989. Oreganon: Southwest Oregon growth and yield model user manual. Version 2.0. Corvallis, Oregon: Oregon State University Forest Research Laboratory. 59 p.

Howard, James O. 1984a. Oregon's Forest Products Industry: 1982. Resource Bulletin PNW-118. Portland, Oregon: U. S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station (pp. 14-16, table 4). 79 p.

Howard, James O. 1984b. California's Forest Products Industry: 1982. Resource Bulletin PNW-119. Portland, Oregon: U. S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station (pp. 15-17, table 4). 79 p.

Howard, James O., and Ward, Franklin R. 1991a. Oregon's Forest Products Industry: 1988. Resource Bulletin PNW-RB-183. Portland, Oregon: U. S. Department of Agriculture, Forest Service, Pacific Northwest Research Station (pp. 14-16, table 4). 91 p.

Howard, James O., and Ward, Franklin R. 1991b. California's Forest Products Industry: 1988. Resource Bulletin PNW-RB-181. Portland, Oregon: U. S. Department of Agriculture, Forest Service, Pacific Northwest Research Station (pp. 14-16, table 4). 91 p.

Larsen, David N. 1992. Washington Mill Survey 1988. Series Report No. 11. Olympia, Washington: State of Washington Department of Natural Resources. (pp. D-6 through D-9, table D-4). [Unconventional pagination].

Larsen, David; Gee, Loran; and Beardon, Donald A. 1983. 1982 Washington Mill Survey. Wood consumption and wood characteristics. Washington Mill Survey Series Report No. 8. Olympia, Washington: State of Washington Department of Natural Resources. (pp. 46-49, table 4). 127 p.

Oregon Forestry. [1986]. Revised 5/87 Oregon timber harvest report. 1985. General file 7-0-4-000. [Salem OR]: Oregon Forestry. [Not paged].

Oregon State Department of Forestry. [1985, 1987]. Oregon timber harvest report. General file 7-0-4-000. [Salem OR]: Oregon State Department of Forestry. [Not paged]. Annual.

Oregon State Forestry Dept. comp. [1988, 1989]. Oregon timber harvest report. General file 7-0-4-000. Salem OR: Oregon Forestry. [Not paged]. Annual.

Sessions, John., coordinator. 1990. Timber for Oregon's tomorrow. The 1989 update. Corvallis, OR. Oregon State University, College of Forestry, Forest Research Lab. 183 p.

Ulrich, Alice H. 1988. U. S. timber production, trade, consumption, and price statistics 1950-86. Miscellaneous Publication No. 1460. Washington DC: U. S. Department of Agriculture, Forest Service. (p. 9, table 1). 81 p.

Ulrich, Alice H. 1990. U. S. timber production, trade, consumption, and price statistics 1960-88. Miscellaneous Publication No. 1486. Washington DC: U. S. Department of Agriculture, Forest Service. (p. 9, table 1 converted to 1967=100 using Ulrich 1988). 80 p.

U. S. Department of Agriculture. 1992a. Final environmental impact statement on management for the northern spotted owl in the national forests. Volume 1. Washington DC: U. S. Department of Agriculture, Forest Service, National Forest System. [unconventional pagination plus supporting maps].

U. S. Department of Agriculture. 1992b. Record of decision. Final environmental impact statement on management for the northern spotted own in

the National Forests. Washington DC: U. S. Department of Agriculture, Forest Service, National Forest System. 22 p.

U. S. Department of the Interior. 1988 [Revised 1988, 1989, 1990]. Planning for the public lands in western Oregon. Proposed State Director guidance. Portland, OR. Oregon/Washington State Office Bureau of Land Management [unconventional pagination].

Warren, Debra D. 1992. Production, prices, employment, and trade in northwest forest industries, third quarter 1991. Resource Bulletin PNW-RB-190. Portland, Oregon: U. S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. (p. 106, table 86). 112 p.

Table 1: Subregion definitions for western Oregon.

SUBREGION	WESTERN OREGON COUNTIES	REPORTING AREA FOR BLM DISTRICT
North Coast	*Clatsop, Columbia, Tillamook, Washington.*	Salem District
Central Coast	*Benton, Lincoln, Polk, Yamhill.*	Salem District
North Willamette	*Clackamas, Multnomah, Hood River.*	Salem District
Mid-Willamette	*Linn, Marion.*	Salem District
Eugene	*Lane.*	Eugene District
Roseburg	*Interior Douglas(1).*	Roseburg District
South Coast	*Coos, Curry, and Coastal Douglas.*	Coos Bay District
Medford	*Jackson, Josephine.*	Medford District

Notes:

(1)The division between Coastal and Interior Douglas County follows the Coos Bay District boundary in Douglas County.

Table 2: Regional market equilibrium results by BLM resource management plan theme.

Bureau of Land Management		TAMM Equilibrium Results	
Resource Management Plan Theme	Allowable Sawtimber Sale Quantity (mmcf/year)	1991-2000 Regional Stumpage Price (1967 $/mbf)	1993-2000 Western Oregon Private Growing Stock Removals (million cubic feet per year)
1984-1988 Historical	197	$37.56	602
NO ACTION(1)	186	$74.22	689
A(2)	245	$70.03	679
B	221	$71.66	682
C(3)	66	$82.07	704
D	77	$81.54	703
E	55	$82.87	706
PREFERRED(4)	94	$80.18	700

mbf- thousand board feet, long log scale.
mmcf/year - million cubic feet per year.

Notes:

(1) Timber Assessment Market Model (TAMM90), log run 582.
(2) Timber Assessment Market Model (TAMM90), log run 583.
(3) Timber Assessment Market Model (TAMM90), log run 584.
(4) Timber Assessment Market Model (TAMM90), log run 587.

Table 3: Silvicultural management regimes used for projecting growth and yield for private lands in western Oregon.

Name of Regime	Acres Assigned To Regime	Management Activities	Comments
RX1, RX1A	2,245,471	Clearcut.	Applied to established stands not eligible for or needing other activities; RX1A allows fertilizer on industrial land in decade prior to clearcut
RX2, RX2B	1,149,234	Commercial Thinning, Clearcut	Applied to established stands that have sufficient stocking to benefit from commercial thinning; RX2B allows fertilization on industrial land prior to both thinning and clearcut.
RX3, RX3A	471,345	Pre-commercial Thinning Clearcut.	Applied to young stands that would benefit from stocking control; generally on ground too steep for commercial thinning; RX3A allows fertilization prior to clearcut on industrial lands.
RX4, RX4B	544,904	Pre-commercial and Commercial Thinning, Clearcut.	Applied to young stands that would benefit from stocking control and then benefit from commercial thinning prior to clearcut; RX4B allows fertilization prior to commercial thinning and clearcut on industrial lands.
RRX1	30,641	Establish Stand, Clearcut.	Applies to bare land or newly regenerated stands, typically on low sites.
RRX3, RRX3A	177,794	Establish Stand, Pre-commercial Thinning, Clearcut.	Applies to bare land or newly regenerated stands typically on ground too steep for commercial thinning; RRX3A allows for fertilizer on industrial ownership prior to clearcut.
RRX4, RRX4B	558,221	Establish Stand, Pre-commercial and Commercial Thinning, Clearcut.	Applies to bare land or newly regenerated stands suitable for both pre-commercial and commercial thinning; RRX4B allows fertilizer on industrial ownership prior to commercial thinning and clearcut.
SWRX1	416,932	Clearcut/Partial Cut.	Applied only in Medford subregion; same as RX1 except allows for a partial cut or clearcut as the regeneration harvest.
SWRX2	78,202	Commercial Thinning, Clearcut/Partial Cut.	Applied only in Medford subregion; same as RX2 allows for a partial cut or clearcut as the except regeneration harvest.
SWRX3	50,320	Pre-commercial Thinning, Clearcut/Partial Cut.	Applied only in Medford subregion; same as RX3 allows for a except partial cut or clearcut as the regeneration harvest.
SWRX4	8,387	Pre-commercial and Commercial Thinning, Clearcut/Partial Cut.	Applied only in Medford subregion; same as RX4 except allows for a partial cut or clearcut as the regeneration harvest.
SWRX5	68,908	Brush Control Clearcut/Partial Cut.	Applied only in Medford subregion; calls for brush control whenever stand is ineligible for pre-commercial thinning and 25% or more of trees are hardwoods.
None	63,779	Not Projected.	Site not suitable for conifer growing stock or other factors precluding management.

Table 5: Results for the 1993-2000 private harvest disaggregation and 2001-2010 projection by BLM resource management plan theme.

	Private Harvest, Western Oregon (million cubic feet per year)					
BLM Resource Management Plan Theme	**1993-2000**			**2001-2010**		
	IND	**NIPF**	**TOTAL**	**IND**	**NIPF**	**TOTAL**
Preferred Alternative (BLM ASQ = 96)	507	193	700	580	226	806
Current Plans (BLM ASQ = 190)	499	190	689	576	223	799
Alternative A (BLM ASQ = 251)	492	187	679	574	220	794
Alternative B (BLM ASQ = 227)	495	187	682	574	223	797
Alternative C (BLM ASQ = 68)	510	194	704	581	226	807
Alternative D (BLM ASQ = 76)	509	194	703	581	226	807
Alternative E (BLM ASQ = 56)	511	195	706	582	226	808
Timber Availability(1) (BLM ASQ = 190)	**544**	**125**	**669**	**557**	**125**	**682**

	IND	**NIPF**	**TOTAL**
1984-1988 Baseline (BLM Harvest = 202)	525	77	602

Notes:
- IND - Private industrial ownership.
- NIPF - Private non-industrial ownership.
- BLM ASQ - Bureau of Land Management resource management plans cumulative allowable sale quantity for western Oregon (million cubic feet per year). Includes the Klamath Resource Area of the Lakeview District.
- BLM Harvest - Bureau of Land Management actual harvest (million cubic feet per year).

(1) Sessions (1990).

Table 6: Log consumption results by BLM resource management plan theme.

BLM Resource Management Plan Theme	Log Consumption by Western Oregon Processing Facilities (million cubic feet per year)							
	1993-2000				2001-2010			
	HARV	END CNSMP	EXOG CNSMP	TOTAL CNSMP	HARV CNSMP	END CNSMP	EXOG CNSMP	TOTAL
Preferred Alternative	1,034	990	169	1,159	1,139	1,086	169	1,255
Current Plans	1,114	1,069	172	1,241	1,225	1,170	172	1,342
Alternative A	1,166	1,118	171	1,289	1,281	1,224	171	1,395
Alternative B	1,144	1,098	171	1,269	1,258	1,203	170	1,373
Alternative C	1,009	966	169	1,135	1,113	1,061	168	1,229
Alternative D	1,015	972	170	1,142	1,120	1,067	170	1,237
Alternative E	1,000	956	168	1,124	1,102	1,050	168	1,218

	HARV	END CNSMP	EXOG CNSMP	TOTAL CNSMP
1984-1988 Baseline	1,248	1,196	172	1,368

Notes:

HARV - Total harvest from all ownerships within western Oregon (million cubic feet per year).

END CNSMP - Consumption of logs originating from ownerships within western Oregon (million cubic feet per year). The difference between HARV and END CNSMP represents the volume of timber originating in western Oregon, but processed by out-of-state or eastern Oregon mills.

EXOG CNSMP - Consumption of logs originating from ownerships from eastern Oregon and out-of-state (million cubic feet per year). Differences reflect the effect of implementing different BLM resource management plan alternatives on Klamath Resource Area of the Lakeview District in eastern Oregon.

TOTAL CNSMP - Total log consumption (all origins) by western Oregon processing facilities (million cubic feet per year).

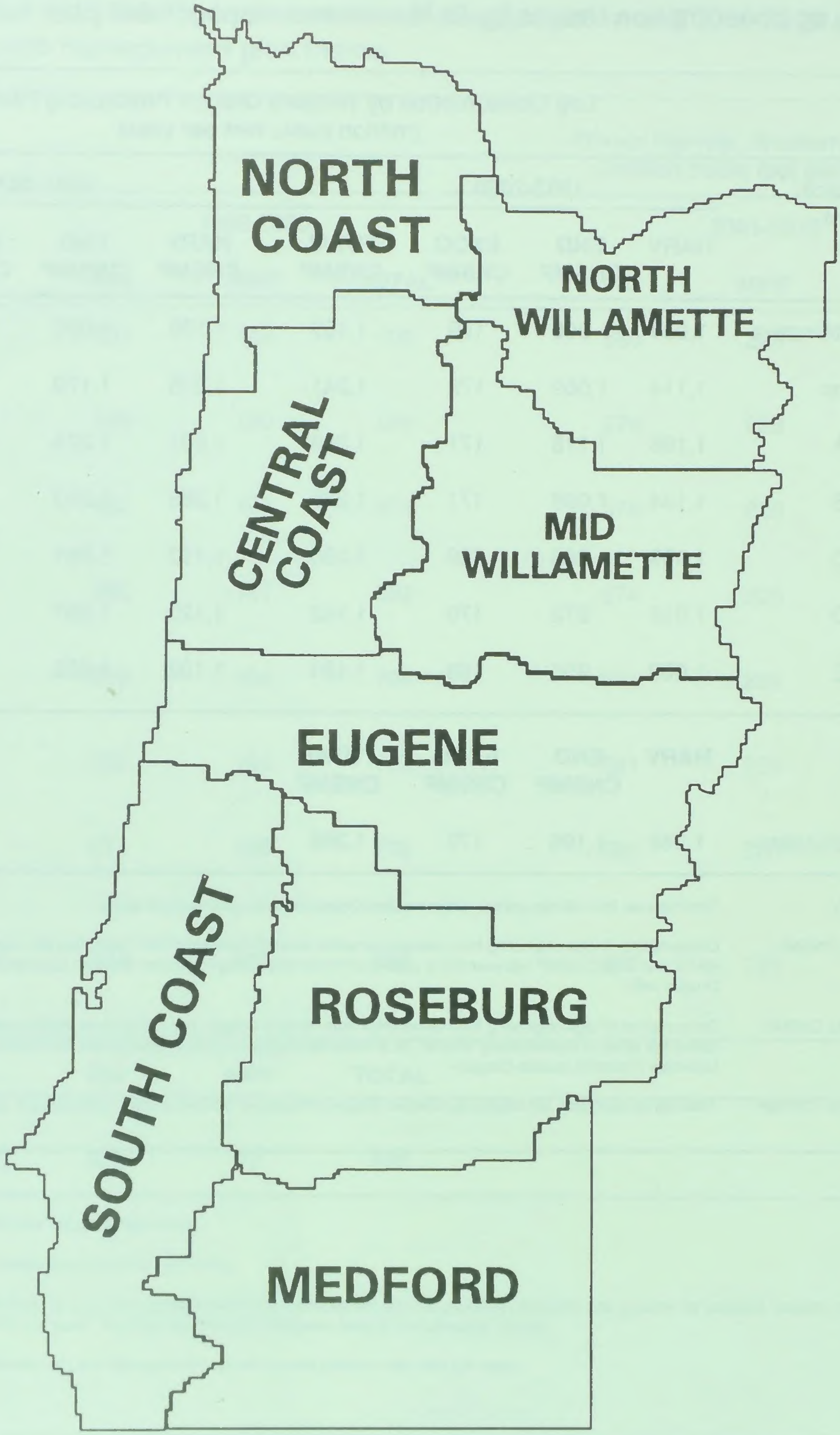


Figure 1: Western Oregon subregions.

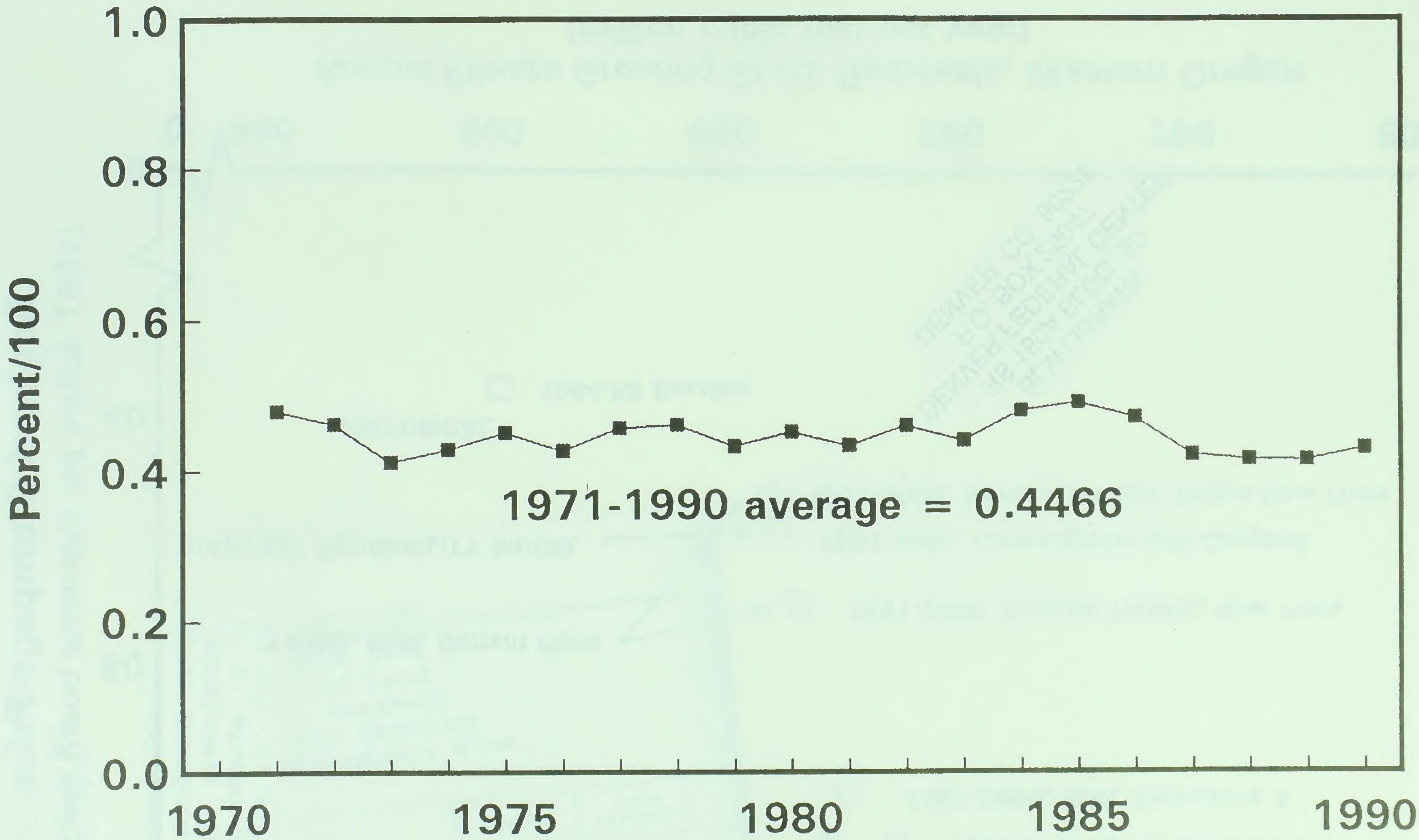


Figure 2: Western Oregon private timber harvest as a proportion of the Pacific Northwest - westside private harvest total.

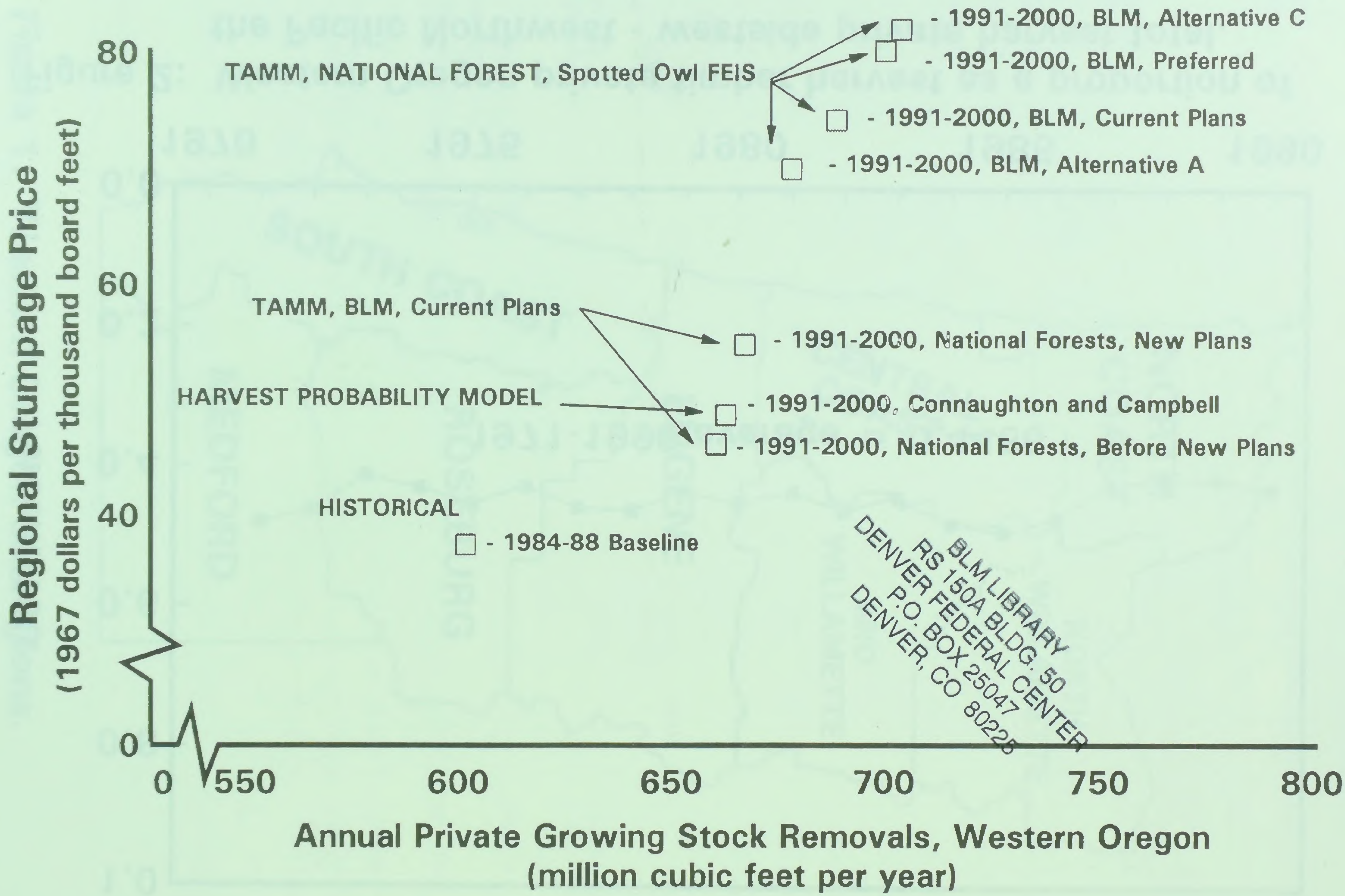


Figure 3: Private harvest calibration for changes in federal timber policy.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1992—691-114/61609 REGION 10